UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to:
OSB1997-0687

December 18, 1997

Chuck Korson
Bureau of Reclamation
Pacific Northwest Region
Lower Columbia Area Office
825 NE Multnomah Street, Suite 1110
Portland, Oregon 97232-2135

RE: Biological Opinion for proposed Milltown Hill Dam

Dear Mr. Korson:

On October 25, 1996 the National Marine Fisheries Service (NMFS) received a Biological Assessment (BA) and request for formal consultation from the Bureau of Reclamation (BOR) on the effects of the proposed Milltown Hill Dam on Umpqua River cutthroat trout. Douglas County proposes to construct, partially fund, and operate the project, with BOR providing the majority iof the funding through a loan and a grant. The Umpqua River cutthroat trout was listed as endangered under the Endangered Species Act(ESA) by NMFS on August 9, 1996 (61 FR 41514; August 9, 1996). Critical habitat has been proposed for this ESU (62 FR 40786; July 30, 1997) and includes the Milltown Hill project area.

NMFS provided draft biological opinions on the MTH project to BOR on April 2 and August 25, 1997. In response to these draft opinions, BOR amended the BA with proposed measures addressing the significant adverse effects of the construction and operation of Milltown Hill Dam on Umpqua River cutthroat trout and its proposed critical habitat, as amended by these proposed measures. The determination is that this proposed project is likely to jeopardize the continued existence of Umpqua River cutthroat trout, and resutl in the destruction and adverse modification of proposed critical habitat for this species. The opinion provides a Reasonable and Prudent Alternative to the proposed action.

Questions regarding this opinion should be directed to Lance Smith (503)231-2307 or Steve Morris (503)231-2224.

Sincerely,

William Stelle, Jr.
Regional Administrator

Enclosure

CC: Frank Nielson, Douglas County Natural Resources
Dave Loomis, Oregon Department of Fish and Wildlife
Ron Garst, U.S. Fish and Wildlife Service
Dan Couch, Roseburg BLM District
Steve Cramer, S.p. Cramer & Associates, Inc.

Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION

Effects of the Milltown Hill Dam on Umpqua River Cutthroat Trout and its Proposed Critical Habitat, Douglas County, Oregon

Agency: U.S. Bureau of Reclamation

Consultation Conducted By: National Marine Fisheries Service
Northwest Region

Date Issued: December 18, 1997

Refer to: OSB1997-0687

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I. Background

On August 9, 1996 (61 FR 41514), the National Marine Fisheries Service (NMFS) listed Umpqua River cutthroat trout (UR cutthroat trout)(*Oncorhynchus clarki clarki*) as endangered under Section 4 of the Endangered Species Act (ESA), 16 U.S.C. 1531 et seq. This evolutionarily significant unit (ESU) includes anadromous, potamodromous, and resident cutthroat trout populations occurring below natural, impassable barriers in the Umpqua River Basin, Oregon. UR cutthroat trout critical habitat has been proposed (62 FR 40786; July 30, 1997) and is described in Attachment 1. On May 6, 1997, NMFS determined that the Oregon Coast (OC) coho salmon (*Oncorhynchus kisutch)* ESU was not warranted for listing under the ESA (62 FR 24588), due primarily to the Oregon Coho Salmon Restoration Initiative (OCSRI), the Northwest Forest Plan (NFP), and other ongoing efforts to protect coho. This ESU occupies river basins on the Oregon coast north of Cape Blanco, excluding rivers and streams that are tributaries of the Columbia River. On August 9, 1996 (61 FR 41541), NMFS proposed to list the Oregon Coast (OC) steelhead (*Oncorhynchus mykiss*) ESU as threatened under the ESA. NMFS has deferred the final decision whether to list OC steelhead until February 1998 (62 FR 43974; August 18, 1997). The OC steelhead ESU occupies river basins on the Oregon coast north of Cape Blanco, excluding rivers and streams that are tributaries of the Columbia River.

On October 25, 1996, the U.S. Department of Interior (USDI) Bureau of Reclamation (BOR) submitted to NMFS a request for formal consultation (for listed UR cutthroat trout) and conferencing (for OC coho and proposed OC steelhead) on the proposed Milltown Hill Dam project (MTH project) pursuant to Section 7 of the ESA, 16 U.S.C. 1536, and implementing regulations at 50 C.F.R. Part 402. The BOR's consultation/conference request was accompanied by a Biological Assessment (BA; USDI 1996a).

The MTH project would be located in the headwaters of Elk Creek (the major tributary to the mainstem Umpqua River) in the Umpqua River Basin in Douglas County in southwestern Oregon. The project, which is estimated to cost $44 million, includes a new dam and reservoir. It will be constructed, owned, and operated by Douglas County, which will provide approximately $13 million of the necessary funding. The BOR proposes to provide the balance of the funding through a federal loan ($25 million) and a federal grant ($6 million). The principal purpose of the project is to partially fulfill the existing and projected needs of urban and rural water users by providing water for agricultural, municipal and industrial uses in the Elk Creek subbasin (USDI 1992).

The BA (USDI 1996a) describes the effects of the project on UR cutthroat trout, OC coho, and OC steelhead, all of which occur in the project area both upstream and downstream of the proposed dam. In response to the BA, on December 11, 1996, NMFS requested additional information on the flow regime in Elk Creek resulting from the project, habitat restoration mitigation measures, and monitoring and evaluation of the project's effects on water quality and flow, aquatic habitat, anadromous salmonids, and macroinvertebrates. BOR responded to the additional information request on January 7, 1997 (USDI 1997a). NMFS provided draft biological opinions on the MTH project to BOR on

April 2 and August 25, 1997. Comments on these drafts were received by NMFS from BOR on June 16 and September 18, 1997.

The objective of this biological opinion is to determine whether the construction and operation of the MTH project is likely to jeopardize the continued existence of the endangered UR cutthroat trout, or result in the destruction or adverse modification of proposed UR cutthroat trout critical habitat. NMFS will make a separate determination for OC coho or OC steelhead in the event that either of these species is listed under the ESA after their final listing.

II. Proposed Action[1]

The proposed damsite is located on upper Elk Creek at river mile (RM) 39.4 in the Umpqua River Basin. Elk Creek originates at an elevation of about 2,000 ft above mean sea level (msl) in the Calapooya Mountains, approximately seven miles southeast of the damsite. It flows westward for approximately 47 miles across northern Douglas County to its confluence with the Umpqua River at Elkton, Oregon. The Elk Creek subbasin covers 290 square miles.

The MTH project consists of a 186 ft-high dam that will create a 24,143 acre-foot reservoir in the headwaters (river mile (RM) 39.4) of Elk Creek in the Umpqua River Basin (see Figure 2 of BA, USDI 1996a). The reservoir will inundate 681 acres of land at the 775 ft msl elevation at normal pool, including about 4.5 miles of Elk Creek and two miles of tributaries (USDI 1992). The project will not include fish passage facilities due to (1) the limited amount of anadromous salmonid habitat that will be blocked by the dam (six to eight miles of coho habitat, 12-16 miles of UR cutthroat trout habitat), 6.5 miles of which will be inundated by the reservoir, and (2) the difficulty in providing for downstream passage of smolts at such a high head facility. In lieu of providing fish passage, the proposal includes instream restoration downstream of the dam as mitigation for the loss of anadromous fish habitat above the dam.

Other proposed project features which may affect fisheries resources include recreational facilities planned for the reservoir area and a 19.6 mile water distribution (pipeline) system which will carry water from the MTH reservoir to Yoncalla Valley and Scotts Valley. Two day-use recreation areas are proposed at the reservoir site, which would include parking lots, picnic sites, shelters, and boat ramps. Sport fishing would be one of the primary recreational uses of the MTH reservoir. Water from the 19.6 mile pipeline will be used to augment low flows by up to 5 ft^3/second (cfs) in the lower 2.5 miles of Yoncalla Creek (current low flows average <1 cfs).

[1]Most of this section is taken from the MTH BA (USDI 1996a).

Flow enhancement, temperature control, and habitat restructuring are features of the project intended to benefit anadromous salmonids. The project would store water during high flow from late fall to early spring, and then augment flow to meet downstream needs during the irrigation season (April 1-October 30) and for anadromous fish habitat enhancement. Most of the Elk Creek mainstem below the project is frequently uninhabitable by salmonids during the summer because flows drop below 1 cfs and water temperatures commonly exceed 75/F (USDI 1992).

Of the total storage provided by the proposed project, 7,737 acre-ft of water annually would be released to ameliorate summertime low flows and high temperatures in the mainstem of Elk Creek (USDI 1992). This water has been secured through a water right obtained by Douglas County for the full 7,737 acre-ft of stored water, which protects it from any downstream appropriation. This water is designated in the water-right permit issued by the Oregon Department of Water Resources to be used specifically to support fish life. The water is reserved for exclusive use by the Oregon Department of Fish and Wildlife (ODFW) at their discretion. The 7,737 acre-ft of water is sufficient by itself to provide a flow of 32 cfs for 4 months, and will be released in most years during June through September as directed by ODFW.

In addition, the Yoncalla Valley pipeline would be used to deliver additional water to the lower 2.5 miles of Yoncalla Creek for stream flow enhancement during the same low flow period. Douglas County has agreed to provide capacity in the Yoncalla Pipeline for an extra 5 cfs that can be used by ODFW at its discretion. Thus, flows in Yoncalla Creek, which generally drop to less than 1 cfs during summer, could be maintained by ODFW at 5 cfs July through September, unless ODFW decides to use the water in Elk Creek. Any water that ODFW uses in Yoncalla Creek will be drawn from the 7,737 acre-ft of water stored for instream use.

The following mitigation for habitat loss upstream of the dam is proposed for Elk Creek downstream of the dam: (1) streamflow augmentation, (2) gravel placement in Elk Creek, (3) structures in Elk Creek, and (4) structures within the reservoir. In Elk Creek, instream modifications will focus on the 3 miles of stream between the damsite and the mouth of Adams Creek (riparian improvements will be focused on the area from Adams Creek to Drain). Instream placements will follow the design guidelines presented in the "Umpqua Fish Management District's Guide to Instream & Riparian Restoration Sites and Site Selection" by Nicholas et al. (1996), and in "A guide to Placing Large Wood in Streams" (ODF and ODFW 1995).

Monitoring and evaluation of fish use of the modified habitats is proposed to be completed in stages during the first five years after the initial release of water from the project. ODFW will oversee the installation of habitat features, review the monitoring of fish use data, and determine the specific location and type of habitat structures during the five year period. Concurrently, the U.S. Bureau of Land Management (BLM), Roseburg District, will complete its watershed analysis of all subbasins within the Elk Creek Basin, and will complete Section 7 consultations under the ESA with NMFS regarding use of federal lands. Data from monitoring of the MTH project, coupled with the watershed analyses performed by BLM, will provide the information needed to refine the proposed habitat restoration components of the project.

The proposed operation of the project is as follows. In years of average or greater runoff, the reservoir would reach full pool during March, drawdown would begin in mid-May, and minimum pool would be reached at the end of September. No storage space would be reserved specifically for flood control, so filling would proceed as rapidly as runoff allowed. A fixed cone valve will be used to discharge water from the dam. This type of valve sprays the water into the air and causes it to re-oxygenate as it plunges back into the tailrace.

Douglas County would complete construction of the MTH project in 3 years, and operation would begin in year four. Construction involving excavation and work within the floodplain is scheduled to begin in 1997, and will be limited to the dry season, approximately May through November. The stream will remain in its natural channel through mid-summer of the first construction season, and during lowest flow in late summer to early fall of that year it will be diverted through a temporary conduit that will allow fish passage. Two temporary sediment ponds will be constructed and all runoff from the construction area will be directed into these ponds by berms and ditches (Moler 1996). Construction of the project would also require relocation of two sections of county road that intersect the pool area and the construction of a service road to the base of the dam where the pipeline is to be placed (USDI 1992; Figure S-3).

Actions implemented by the Bureau of Land Management (BLM) in conjunction with the MTH project include issuing a right-of-way grant to allow a rock quarry operator to traverse BLM land, and the harvest of timber within the inundation area. These actions are considered part of the proposed action, were included in the BA, and are covered by this opinion (BLM has agreed that BOR is the lead action agency for the consultation on this project).

III. Biological Information and Critical Habitat

The listing status and biological information for UR cutthroat trout (listed as endangered) is described in Attachment 1. UR cutthroat trout critical habitat has been proposed (62 FR 40786; July 30, 1997) and is described in Attachment 1. Following is information in addition to that provided in Attachment 1 for the only currently listed anadromous salmonid species, UR cutthroat, that would be affected by the proposed MTH project.

A. UR Cutthroat Life History

Since the proposed MTH Dam will affect the entire mainstem of Elk Creek by blocking habitat above the damsite and altering flows below it, a more thorough discussion of UR cutthroat life history (especially habitat use by the anadromous life form) than is provided in Attachment 1 is necessary to analyze the likely effects of the project on this species. This section describes coastal cutthroat trout spawning, rearing, and smolting.

1. Spawning. Anadromous cutthroat trout generally spawn in the tails of pools located in small tributaries at the upper limit of spawning and rearing sites of coho salmon and steelhead. Stream conditions are typically low stream gradient with summer low flows of #3 cfs, with the peak spawning period occurring in February in Oregon (Johnston 1981). Jones and Seifert (1995) found that anadromous cutthroat in Alaska migrated high into headwater streams in late winter and spring, often moving up and down several such streams before spawning in them. Spawning takes place in low-gradient riffles 15-45 cm deep, and the fish choose clean, pea-sized gravel to build their redds (Trotter 1989). Spawning sites are not far from deep pools, often in the lower, shallow ends of the pools themselves (Hunter 1973, and Jones 1978, both in Trotter 1989).

2. Rearing. UR cutthroat trout rearing habitat needs are particularly important in determining the likely effects of the proposed project on this species. Details based on the current scientific literature are provided below. The habitat of the fry (emergence to age 1) and anadromous parr (age 1+ to smolt) life stages are described separately.

a. Fry rearing habitat. Eggs begin to hatch within six to seven weeks of spawning, depending on water temperature. Alevins remain in the redds for a few additional weeks and emerge as fry between March and June, with peak emergence in mid-April (Giger 1972, Scott and Crossman 1973). Newly emerged fry are about 25 mm long. They prefer low velocity margins, backwaters, and side channels, gradually moving into pools if competing species are absent. Bisson et al. (1988) studied habitat use by juvenile salmonids in several third and fourth order streams of western Washington, and found a sharp difference in habitat preference of age 0+ cutthroat from that of older age groups. Age 0+ cutthroat preferred backwater pools and glides, but avoided dammed and trench pools, whereas age 1+ and older cutthroat preferred lateral scour and plunge pools.

Cutthroat fry do not appear to stray far from where they were hatched during their first year. E.g., Moore and Gregory (1988) found that coastal cutthroat fry exhibited only limited instream movement, and that after emerging from spawning gravel, young fish resided near the redds along the margins of streams until the end of summer when they moved out into foraging stations in pools. Also, Dewitt (1954) surveyed coastal cutthroat in streams of northern California and found that 0+ fish were only found in very small tributaries, usually with summer flows less than 1 cfs. Sumner (1972) seined monthly in small tributaries of Sand Creek, a tributary of an Oregon estuary, and found that age 0+ cutthroat remained in the small natal tributaries until the end of the first winter, by which time they had reached a mean length of almost 3 inches. They then began to move downstream as emergent fry began to appear in the spring from the next age group. Most age 1+ fish had emigrated from these small tributaries by the end of June.

This is consistent with Trotter's (1989) description of cutthroat fry movement; "Juvenile cutthroat trout that survive their first winter range more widely than young-of-the-year fish (Giger 1972). Sometimes as early as the winter of their first year, but more generally in the spring, many begin downstream movement to the main stem. The onset of winter freshets triggers an upstream movement that often takes the fish back into the tributaries." Similarly , Fuss (1982) concluded that "large numbers of juvenile fish emigrate from smaller tributary streams during the spring, and essentially cease during the summer."

b. Anadromous parr rearing habitat. As noted above, after emergence from redds, cutthroat trout fry generally remain in upper tributaries near their redds until they are about one year of age. From the age of 1+ until smolting (the parr stage, which may last one to four years), anadromous cutthroat typically move extensively up and down streams, often from headwater areas to the estuary and back. Directed downstream movement by parr usually begins in the spring (Giger 1972), but has been documented in every month of the year (Sumner 1953, 1962, 1972; Giger 1972; Moring and Lantz 1975; Johnston and Mercer 1976; Johnston 1981). E.g., from 1960 to 1963 (Lowry 1965) and from 1966 to 1970 (Giger 1972) in the Alsea River drainage, large downstream migrations of juvenile fish began in mid-April with peak movement in mid-May. In Oregon, upstream movement of parr from estuaries and mainstems to tributaries begins with the onset of winter freshets during November, December, and January (Giger 1972).

When habitat is available (e.g., large pools in streams, cool temperatures), anadromous cutthroat parr utilize larger streams or estuaries before smolting. E.g., Frissell (1992) estimated juvenile salmonid populations in the Sixes River basin during 1987-89 and found that 93% of the estimated abundance of age 1+ and 2+ cutthroat trout was in the lower basin, with only 6% and 1% in the upper and middle basin, respectively. The 93% does not include an estimate of cutthroat rearing in the estuary, although age 1+ and 2+ cutthroat were present there. Giger (1972) found that some parr entered the estuary and remained there over the summer, although they did not smolt nor migrate to the open ocean. He noted that "The spring downstream shifting or progression of non-smolting juvenile cutthroat is a logical feature for this species which spends from two to five years in freshwater before migrating to sea." Parr captured in the estuary were about 55% age 2 and 40% age 3. Mean length of parr was 146 mm while the mean length of smolts was 231 mm (Giger 1972).

Anadromous cutthroat parr may move downstream before smolting and reside in pools in relatively large streams throughout the summer when habitat is available. E.g., Sumner (1972), using downstream migrant traps in tributaries to the Kilchis River from April through July 1946, found that about 75% of the several hundred outmigrating cutthroat he caught were parr averaging 5.2 inches (the other 25% were smolts averaging 6.8 inches). Lowry (1965) studied cutthroat movements in three streams in the Alsea River Basin for 3-4 years each, and found that tagged fish over 125 mm fork length generally remained in the same pool from June through October. All tagged fish moved upstream and into tributaries in fall and downstream to the mainstem in spring. The utilization of downstream habitat by cutthroat parr is related to food availability, evidence for which is noted by Sumner (1962); "The stream-growth pattern of spaced circuli enlarges as the trout grows, moves downstream, and feeds on larger food items. Thus, the spacing of circuli in lower-stream and tide-water growth approaches the spacing of the salt-water pattern."

Fuss (1982) studied anadromous cutthroat populations in streams of the northern Olympic Peninsula, and noted, "Fish that resided in streams or certain areas of streams that contained high quality habitat, appeared to be larger at a given age. This was also true of fish occupying the lower sections of streams." Fuss also observed that older and larger juveniles (ages 3 and 4) tended to occupy high quality pools, and that these older parr were more abundant in the lower reaches of streams. Dambacher (1991) used snorkel surveys to estimate steelhead and coastal cutthroat parr abundance in Steamboat Creek (Umpqua Basin) during the summers of 1987 and 1988. He found cutthroat parr in all reaches of this stream and its tributaries, including the lower reaches (maximum flow of 49 cfs in August), although steelhead parr were approximately ten times more abundant in these reaches. Nawa et al. (1992) used snorkel surveys to count cutthroat in coastal rivers during August for four years. They found densities of age 1+ and older cutthroat in each reach of the Salmonberry River ranging from 21 to 95 fish per km in the year of highest abundance, and 0 to 60 fish per km in the year of lowest abundance. In the Wilson River, cutthroat density was 24 fish per km in August 1991 when the flow was 97 cfs. These results demonstrate that anadromous cutthroat parr make substantial use of mainstem habitat during the summer.

c. Temperature Effects. Little information is available on temperature tolerance in coastal cutthroat trout as most work has been done on inland cutthroat. Working with inland cutthroat, Bell (1986) found that preferred temperatures for spawning and incubation were 6.1° (43°) to 17.2°C (63°F), and Dwyer and Kramer (1975) determined that maximum scope for activity was achieved at 15°C (59°F). Heath (1963, in Johnson et al., 1994) found that juvenile sea-run cutthroat preferred water temperatures around 15°C. In a variety of studies (Hunter 1973, Golden 1975, Behnke and Zarn 1976, Behnke 1992; all cited in Johnson et al., 1994), inland and coastal cutthroat trout, like other salmonids, were not usually found in water temperatures higher than 22°C (72°F). Dwyer and Kramer (1975) believed that 24°C (75°F) is near the upper lethal temperature for inland cutthroat trout.

Frissell's (1992) results from the Sixes River Basin in southwest Oregon suggest coastal cutthroat are relatively intolerant of high stream temperatures compared to other anadromous salmonids; "Among stream segments where we had both temperature and biological data for 1987-1989, the diversity of the salmonid assemblage, measured by the number of species and age classes observed, declined as maximum water temperature increased. This pattern reflected a progressive loss of thermally sensitive species with warming. The coolest streams held all four species, including three age classes of rainbow and cutthroat trout. Cutthroat, coho, and chinook dropped out in sequence as maximum temperature increased, with rainbow trout the only species present in waters exceeding 23/C." He also notes that high stream temperatures are a limiting factor in his study area; "It seems clear, however, that the distribution of juvenile salmonids in Sixes basin is at least partly constrained by summer temperature and that increases in temperature are likely to further stress populations by limiting their movements, possibly capping density or reducing growth in important habitats, and perhaps eliminating key life history options with the imposition of new thermal barriers. Conversely, cooling could remove or relieve such constraints, perhaps result in nonlinear increases in certain habitats and species."

3. Smolting. Most juveniles smolt between ages 2+ through 4+, with the fastest growing fish at each age becoming smolts. Growth rate is related to habitat quality (which includes stream size), and slower growing individuals must survive more years before smolting (Sumner 1962; Giger 1972; Sumner 1972; Fuss 1982; Frissell 1992). Data from Sumner (1962) and Giger (1972) demonstrate that faster growing fish tend to smolt at a younger age; in four different coastal streams where scales had been collected and analyzed from large numbers of adult searun cutthroat, the scales consistently showed that fish which smolted at successively older ages grew slower and were smaller at each age than those that smolted at a younger age. For example, Sumner (1972) showed from scales of returning adults in Sand Creek, that fish which had smolted at age 2 averaged 165 mm at their second annuls, while fish that smolted at age 3 averaged only 127 mm at their second annulus. Giger (1972) noted a similar trend for searun cutthroat sampled in the Alsea, Siuslaw, and Nestucca rivers during 1965 through 1975. Thus, the faster the growth of anadromous cutthroat parr, the quicker they will smolt, and, as noted by Sumner (1962), these parr grow faster in larger streams and tidewater.

B. **Critical Habitat.** UR cutthroat trout critical habitat has been proposed (62 FR 40786; July 30, 1997) and is described in Attachment 1.

IV. Evaluating Proposed Actions

The standards for determining jeopardy are set forth in Section 7(a)(2) of the ESA, 16 U.S.C. 1536(a)(2), and implementing regulations at 50 CFR Part 402. Attachment 2 describes how NMFS applies the ESA jeopardy standards to consultations on Federal actions. UR cutthroat trout critical habitat has been proposed (62 FR 40786; July 30, 1997), and the effects of the MTH project on critical habitat are described in "**V. Analysis of Effects, B. Critical Habitat"** below.

As described in Attachment 2, the first steps in applying the ESA jeopardy and destruction or adverse modification of critical habitat standards are to define the biological requirements of the ESU and to describe the listed species' current status under the environmental baseline. In the next steps, NMFS's jeopardy and destruction or adverse modification of critical habitat analysis considers how proposed actions are expected to directly and indirectly affect specific environmental factors that define properly functioning aquatic habitat essential for the survival and recovery of the species. This analysis is set within the dual context of the species' biological requirements and the existing conditions under the environmental baseline (defined in Attachment 1). The analysis takes into consideration an overall picture of the beneficial and detrimental activities taking place within the action area. If the cumulative actions are found to jeopardize the listed species, or destroy or adversely modify critical habitat, then NMFS must identify any reasonable and prudent alternatives to the proposed action.

A. Biological Requirements

For this consultation, NMFS finds that the biological requirements of the UR cutthroat trout are best expressed in terms of environmental factors that define properly functioning freshwater aquatic habitat necessary for survival and recovery of the ESU. Individual environmental factors include water quality, habitat access, physical habitat elements, channel condition, and hydrology. Properly functioning watersheds, where all of the individual factors operate together to provide healthy aquatic ecosystems, are also necessary for the survival and recovery of UR cutthroat trout. This information is summarized in Attachment 1.

B. Environmental Baseline

Current range-wide status of UR cutthroat under environmental baseline. NMFS described the current population status of the Umpqua River cutthroat trout ESU in its status review (Johnson et al., 1994) and in the final rule (August 9, 1996, 61 FR 41514). The fish counts at Winchester Dam on the North Fork Umpqua River provide the best quantitative source of information on cutthroat trout abundance in the Umpqua River Basin (see Attachment 1, Table 1). However, for the purposes of this biological opinion, it is difficult to determine the population status for the environmental baseline assessment of the entire ESU based only on Winchester Dam fish counts because this dam is located on the North Umpqua River while the ESU occupies the entire Umpqua Basin. In the absence of adequate population data, habitat condition provides a means of evaluating the status of Umpqua River cutthroat trout for the environmental baseline assessment, as explained in Attachment 1.

Action Area. The "action area" is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." 50 CFR 402.02. Some components of the proposed MTH project, such as quarrying of rock for dam construction, road relocation and construction, municipal and irrigation water delivery, and off-site mitigation will be done at various locations throughout the Elk Creek subbasin, hence this entire subbasin is considered as the action area (not to be confused with the Elkhead Watershed, where the MTH dam is to be located).

Current status of UR cutthroat under environmental baseline within the action area. Little information is available on the current status of anadromous salmonids in the Elk Creek subbasin, particularly for UR cutthroat trout. The most recent estimates of annual returning coho and steelhead adults in Elk Creek are from 1989, when Craven (1989a) estimated that 500 adults of each species were using this stream. In Elkhead Watershed (the watershed where the MTH project would be located), Craven (1989b) reported that an ODFW spawning survey found six adult coho and fifteen redds near RM 45 on Elk Creek, which would be near the upper end of the proposed reservoir. There is no information, historical or current, on the status of UR cutthroat trout in Elk Creek, although CH_2M Hill (1995) and USDI (1996b) both documented the presence of UR cutthroat trout in the project area. While there is a lack of information on the current status of UR cutthroat trout in the action area, environmental baseline conditions can be used to infer the likely current status of wild fish that depend on properly functioning aquatic habitat. Hence a description of the environmental baseline within the action area is given below.

Elk Creek is currently a poor producer of anadromous salmonids and other native aquatic organisms due to the lack of spawning substrate and instream habitat complexity, as well as high summertime water temperatures (Craven 1989a, USDI 1996b). Spawning and rearing habitat for anadromous and resident fish is sparse, especially during low flows. Although the present lack of habitat diversity in Elk Creek below the damsite has probably resulted from land use practices such as logging and agriculture, no historical accounts of fish habitat prior to major disturbance are available. USDI (1996b) identified lack of large woody debris and excessive sediment as limiting factors for fish in upper Elk Creek, and high temperatures and low water as limiting factors in lower Elk Creek. Fish habitat simplification, such as that found in Elk Creek, commonly results from timber harvest, agriculture, and other human activities (FEMAT 1993).

Late summer flows are generally less that 5 cfs and frequently approach 0 cfs, whereas average winter and spring flow are about 800 to 1,000 cfs (USDI 1992). USDI (1996b) states that “[a]n inventory of water rights for the Elk Creek watershed in 1993 lists 254 appropriated permits totaling 38.42 ft^3/s. The restriction on these water rights are not known. Domestic water withdrawal, irrigation, agriculture, and livestock watering have all contributed to the lower volumes of water being present in the stream channels during the summer months.” USDI (1996b) also notes that stream cleaning (i.e., removal of wood), road building, and riparian timber harvest have occurred throughout the Elk Creek subbasin, and have probably also contributed to the current summer low flows. USDI (1996a, 1997a,b) suggests that summer low flows in the Elk Creek subbasin were historically low, possibly due to lack of snowpack in this relatively low elevation watershed. Regardless of historical hydrologic conditions in the Elk Creek subbasin, USDI (1992, 1996a,b, 1997a,b) acknowledges that the current problem of summer low flows has been exacerbated by human activities.

Elk Creek is a relatively low gradient stream (<1%) that has a fairly uniform bedrock substrate and many long runs (or pools) with few riffles. Craven (1989c) estimated a pool/riffle ratio of 95% pools to 5% riffles. Pools in the upper reaches of Elk Creek ranged in size up to 100 feet in length with a depth of one to two feet, and in the lower stream reaches the pools ranged up to one-quarter mile in length with a depth of three to four feet. Most of these pools occur in the lower part of the creek below the town of Drain. They provide considerable fish rearing potential in Elk Creek, but they contain little if any shelter such as boulders and wood debris required by young fish. The area above the proposed damsite has considerable woody debris and other instream structure (Craven 1989c, Bowerman 1997). The mainstem of Elk Creek lacks significant gravel sources. Some gravel deposits occur along the stream banks and in the small tributary streams, but gravel represented only 12% of the area in transects surveyed from RM 26.2 to RM 35.5, and only 8% of the area throughout the entire Elk Creek mainstem (Craven 1989c). Sand and silt over bedrock covered much of the area surveyed.

Riparian vegetation provides shading throughout the summer months in most areas in the upper Elk Creek subbasin. However, several areas between Scotts Valley and Boswell Springs and in Putnam Valley have sparse riparian vegetation. The areas of sparse riparian vegetation appear to have resulted from land use practices. Adequate riparian vegetation is essential for salmonid habitat in small streams such as Elk Creek and functions to provide much more than just shading, e.g., (1) streambank stability (through its roots), (2) formation of overhanging and undercut banks, (3) supply of large woody debris to streams, (4) input of organic matter (leaves), (5) accumulation of sediment during peak flows, upon which more plants grow, and (6) filtration of sediments from uplands (FEMAT 1993, Beschta 1997). As noted in USDI (1996b), large woody debris is a limiting factor in upper Elk Creek; thus, riparian vegetation does not appear to be providing these functions in most of this area. As noted by Craven (1989c) and Bowerman (1997), there are areas of Elk Creek above the damsite that contain considerable large woody debris may be an exception to this general condition.

High water temperature during the summer and early fall is a limiting factor for fish in lower Elk Creek. Douglas County has monitored water temperature in Elk Creek for several years with thermographs and spot measurements (USDI 1992). Mean monthly water temperature for July and August from 1987 to 1990 was 16.9°C (62.4°F) at Elkhead (RM 37.5) and 19.2°C (66.6°F) at Boswell Springs (RM 26.5). Water temperatures along the entire length of Elk Creek were measured twice a month from July through September in 1990. The results showed a sharp increase from just below Drain (RM 22.8) downstream to the mouth, when the eight measuring stations in this reach had stream temperatures ranging from 21.1°C (70°F) to 27.8°C (82°F) on July 17, July 31, and August 14 (USDI 1992).

Extensive habitat surveys by ODFW of Elk Creek tributaries and upper Elk Creek have shown that habitat quality in the stream reaches above the proposed damsite (10% of the Elk Creek subbasin) is similar to tributary habitat throughout the other 90% of the subbasin (ODFW 1996a; USDI 1997a,b). Most stream reaches above the damsite rated “fair-high risk” or “poor”, while only one small reach above the dam rated “fair-low risk”. This is similar to most other Elk Creek tributaries, where fair-high risk or poor stream conditions prevail from the confluence with Elk Creek to the headwaters, particularly in the eastern half of the subbasin (see Figure 1 of USDI 1997b).

Based on the best information available on the current status of UR cutthroat trout rangewide (Attachment 1) and within the action area, the information available regarding population status, population trends, and genetics (see Attachment 2), and the poor environmental baseline conditions within the action area, NMFS concludes that not all of the biological requirements of the UR cutthroat trout within the action area are currently being met under the environmental baseline. Actions that do not retard attainment of properly functioning aquatic conditions when added to the environmental baseline would not jeopardize the continued existence of anadromous salmonids such as UR cutthroat trout (see “VI. Conclusion, A. Standard jeopardy and destruction/adverse modification of critical habitat analysis” below and Attachment 2).

V. Analysis of Effects

A. Effects of the Proposed Action. This section is divided into the following subsections:

1. Migration Barrier and Habitat Loss
2. Dam Construction
3. Alterations in Flow and Water Quality
4. Change in Sediment Transport and Storage
5. Mercury Bioaccumulation
6. Mitigation
7. Monitoring and Evaluation
8. Interrelated and Interdependent Actions

1. Migration Barrier and Habitat Loss. Reservoir inundation and blockage of fish access to the reservoir tributaries (the proposed MTH Dam will not include fish passage facilities) will result in a loss of at least 6 miles of coho habitat and 8.5 miles of anadromous UR cutthroat trout and steelhead habitat (USDI 1996). This is a minimal estimate of the amount of anadromous UR cutthroat trout habitat that will be lost, since anadromous coastal cutthroat often use very small streams for spawning and first year rearing (Johnston 1981). For example, Jones and Seifert (1995) found that anadromous cutthroat in Alaska migrated high into headwater streams in late winter and spring, often moving up and down several such streams before spawning. Assuming UR cutthroat trout use streams of this size, the MTH project would result in the loss of at least 12 miles of UR cutthroat trout habitat. Non-anadromous UR cutthroat trout will inhabit the reservoir and its tributaries after the dam is constructed, but gene flow between this population and the anadromous UR cutthroat trout populations downstream will cease (with the possible exception of some reservoir UR cutthroat trout moving downstream of the dam via spill).

Optimal damsites are often located at narrow bedrock constrictions below wide, aggraded valleys, which allow large storage ratios for a given dam size. When undisturbed or ecologically functional, these aggraded, alluvial reaches correspond to highly productive riverine habitats for fishes and other native biota (ISG 1996). The MTH project is located at such a site: the damsite is in a steep, narrow canyon with >5% stream gradient (RM 39.4); half a mile above the damsite, the channel opens into a wide valley through which the stream meanders for several miles (. RM 40 to RM 44) at <1% gradient. However, most of the stream reaches above the damsite are heavily disturbed and ecologically nonfunctional, according to ODFW’s Aquatic Habitat Inventory results (ODFW 1996a), tabulated and mapped in USDI (1997a,b; see Figure 1 in USDI 1997b. However, as noted by Craven (1989c) and Bowerman (1997), there are areas of Elk Creek above the damsite that contain considerable large woody debris and appear to be ecologically functional.

Many alternative sites were considered as possible locations for the Milltown Hill project. Selection of a site was dependant on identifying an available and geotechnically suitable location that (1) had sufficient runoff to provide adequate water storage for anticipated needs, (2) was high in the watershed to minimize impacts on spawning habitat of anadromous fish, and (3) had potential for improving downstream habitat for anadromous fish (USDI 1992). ODFW opposed many of the damsites investigated by Douglas County, but approved the selection of the proposed site for the Milltown Hill project for the following reasons: (1) it is located in the uppermost part of the Elk Creek watershed (i.e., upper 10%) where few anadromous fishes reach, (2) substantial fisheries benefits could be produced downstream by enhancing flow because the mainstem of Elk Creek is currently little used by salmonids through the summer due to high temperatures and low flows, (3) the limited fish habitat above the dam is in degraded condition, thus very little, if any, high quality habitat would be lost, and (4) 40% of the water supply entering the reservoir is from Walker Creek, which is already inaccessible to anadromous fish, because of an impassable falls within 100 ft of its confluence with Elk Creek (personal communication, Dave Loomis, ODFW, Roseburg; USDI 1997b).

Highly respected scientific panels and fisheries biologists, such as the National Research Council (NRC 1996), the Independent Scientific Group (ISG 1996), the Bradbury Work Group (Bradbury et al. 1995), Mantech Environmental Research (Spence et al. 1996), and the Forest Ecosystem Management Assessment Team (FEMAT 1993), have recently and consistently recommended that protection of the best remaining habitat should be the first step in any watershed restoration strategy aimed at anadromous salmonid recovery. As noted above, according to ODFW's Aquatic Habitat Inventory results (ODFW 1996a), tabulated and mapped in USDI (1997a,b), the stream reaches above the damsite are of average (or worse) quality compared to other tributary streams in the Elk Creek subbasin.

ODFW's Aquatic Habitat Inventory results appear to conflict with USDI's (1996b) East Elk Creek Watershed Analysis report, which suggests that the stream reaches above the damsite may be of relatively high value for fish. However, results from ODFW's Aquatic Habitat Inventory (ODFW 1996a) and USDI's (1996b) watershed analysis should not be compared because (1) they surveyed two different things (aquatic habitat quality vs. fish populations), and (2) ODFW surveyed all streams in the Elk Creek subbasin regardless of ownership (except most of the mainstem) while USDI (1996b) only sampled fish populations in some stream reaches on federal land (17% of the Elk Creek subbasin). Because ODFW's Aquatic Habitat Inventory is for all stream reaches in the Elk Creek subbasin regardless of land ownership (except most of the mainstem below the damsite), NMFS considers this to be the best available information on aquatic habitat for the Elk Creek subbasin as a whole, as well as for Elkhead Watershed above the damsite.

Although the anadromous salmonid habitat above the MTH damsite is currently degraded, NMFS believes that it has a high potential for recovery because of two recent major aquatic habitat restoration efforts that are being implemented in western Oregon, including the Elk Creek subbasin: the Oregon Coastal Salmon Restoration Initiative (OCSRI, on non-federal land) and the Northwest Forest Plan

(NWFP, on federal land). In response to NMFS's proposal to list Oregon's coho salmon under the ESA in 1995, the OCSRI was completed (State of Oregon, 1997) and submitted to NMFS in March 1997. In the April 28, 1997, Memorandum of Agreement between the State of Oregon and NMFS on the OCSRI, Oregon committed to "seek to strengthen or clarify measures" in the forest and agricultural practices sectors (among others) with the objective of protecting and restoring coho habitat. Coho habitat on non-federal land that is affected by forestry and agricultural practices, such as that above the MTH damsite, should be better protected in the future due to the OCSRI. On federal land (.30% of watershed above MTH damsite), the quality of aquatic habitat is expected to improve relatively quickly due to the stringent standards and guidelines of the NWFP.

2. Dam Construction.[2] Direct effects of construction (including the effects of interrelated and interdependent actions) are those which alter fish passage, the streambed, the flows, the water quality, and the watershed. Construction involving excavation and work within the flood plain may begin in 1997, and will be limited to the dry season, approximately May through November. According to the Erosion and Sediment Control Plan for the project (Moler 1996), the stream will remain in its natural channel through mid summer of the first construction season. The creek will be protected from contamination from excavated soil, rock, and concrete by cofferdams. Disturbance of the actual creek bed is expected to be minimal, and temporary bridges will be built across Elk Creek and Walker Creek in the construction area, so that vehicles can cross without disturbing the stream.

During lowest flow in late summer to early fall of the second construction season, the creek will be diverted permanently through the outlet conduits. Fish passage from below the damsite to above the active construction area will become permanently blocked at that time. No provision will be made for fish passage. During the late summer or early fall of the first season, the creek will be diverted through a temporary conduit that will allow fish passage. Sediment loads in the creek are expected to increase for only a matter of hours at that time (Moler 1996). Even then, sediment loads downstream will be small, because a cloth silt barrier will be placed across the stream below the construction site.

Construction of the dam and other project facilities would cause temporary turbidity in Elk Creek. The impacts would be minor and short-lived. Soils in the reservoir area are composed of alluvial deposits of silt, sand and gravel. The potential for impacts from erosion is moderate. Erosion control measures would minimize siltation in Elk Creek (USDI 1992). A detailed Erosion and Sediment Control Plan has been prepared by the engineering firm on the project, Montgomery Watson (Moler 1996), to preclude sediment caused by dam construction from entering Elk Creek. The requirements for erosion control will be written into the contracts, and will be enforced by Montgomery Watson through the Construction Manager on site full time during construction. The plan includes a variety of general measures targeting construction practices and describes several site specific measures to control erosion and sediments in disturbed areas.

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[2]This section is entirely from the MTH BA (USDI 1996a).

Two temporary sediment ponds will be constructed and all runoff from the construction area will be directed into these ponds by berms and ditches. Excavation on each abutment will be sloped to drain into sediment ponds at the upstream and downstream end of the excavation on either bank. Silt fences will also be placed in the stream during May through October to capture sediments missed by the drainage network. The Erosion and Sediment Control Plan also specifies permanent measures to minimize sedimentation in the stream after construction is complete. Permanent measures include culverts, rip rap bank stabilization, revegetation of disturbed areas, and regrading of disturbed slopes.

Construction of the project would also require relocation of two sections of county road that intersect the pool area and the construction of a service road to the base of the dam where the pipeline is to be placed (USDI 1992; Figure S-3). The road below the dam, known as Dark Canyon Road, would be subject to the measures of the Sediment and Erosion Control Plan, and would not cross or affect the streambed (most of this road has already been constructed). This road will require a right of way from the Bureau of Land Management. The construction of other components of the MTH project which may affect fisheries resources include recreational facilities (two day-use recreation areas are proposed at the reservoir site) and a water distribution system (19.6 mile, 30" diameter pipeline) which will carry water from the MTH reservoir to Yoncalla Valley and Scotts Valley.

3. Alterations in Flow and Water Quality. The proposed MTH project will alter flows and water quality parameters in Elk Creek. The “Alterations in Flow” component of this section is divided into stream habitat and fish population sections.

a. Alterations in Flow: Effects on stream habitat. The proposed operation of MTH Dam would alter the flow regime of Elk Creek by reducing peak flows (for several miles downstream of the damsite) and increasing base flows (from the damsite to the mouth). Peak flows create fish habitat by mobilizing channel substrate material and recruiting coarse sediment from the floodplain and redistributing it throughout the channel. Reduced peak flows typically cause channels to become static and disconnected from their floodplains (ISG 1996). Reduction in peak flows stabilizes and simplifies the channel, as the stream no longer cuts against banks and terraces. This creates a less dynamic stream that is geomorphologically stagnant, since its ability to create new habitat has been reduced or eliminated. For example, the upper McKenzie River has flood control dams in 27% of the watershed, resulting in significant peak flow reductions in the mainstem. The reduced connection with the floodplain has caused the channel to gradually simplify over the past thirty years for the reasons given above. This has resulted in a decline in spawning gravel recruitment in the stream, which appears to be limiting salmon production (Ligon et al., 1995). Altering base flows does not affect streams as significantly as reducing peak flows, but rapidly fluctuating base flows can affect sediment transport in a stream (e.g., by sluicing fine sediment out of the stream substrate) (ISG 1996).

The hydrologic processes that create and maintain fish habitat are already degraded in Elk Creek. The reduction in peak flows proposed for the MTH project may worsen this situation. To predict the likely effects of peak flow alterations on stream habitat for the MTH project, it is necessary to determine (1) the sensitivity of the existing channel geometry to changes in sediment supply and streamflow, and (2) the magnitude of change in streamflow regime and sediment supply due to the project. Information on the affected channel substrate is also necessary to predict the likely effects of base flow alterations on stream habitat due to this project. An assessment of the effects of the MTH Dam on the stream channel and streamflows of Elk Creek was conducted by Trihey (1997, Attachment 4 of this opinion), which formed the basis of the "Existing channel geometry", "Streamflow regime", and "Conclusion" sections below.

1. Existing channel geometry. Trihey (1997) notes that, based on the available information, the channel gradient, cross-section and bedforms of Elk Creek below the damsite are strongly influenced by bedrock. The channel planform is also affected by bedrock. A high degree of bedrock influence is persistent throughout much of Elk Creek between the damsite and its confluence with the Umpqua River (about 40 miles downstream). It also appears that sediment transport capacity in the vicinity of the project site is higher than the available sediment supply under existing conditions. Trihey (1997) concluded that "the Elk Creek mainstem is not a fully adjustable alluvial channel that is primarily shaped by erosion and deposition processes associated with annual floods (or 'bankfull discharge'). Its stream boundaries are primarily formed by materials that are not moved under bankfull flow, although a veneer of cobbles, gravel and sand form a portion of the channel bed materials. These characteristics make the Elk Creek channel geometry less dependent upon small magnitude, high frequency events and more dependent on moderate and high magnitude events which are infrequent and which the proposed project has little ability to modify."

2. Streamflow regime. The drainage area upstream of the proposed damsite is just over 27 square miles, while that of the Elk Creek at its mouth is about 290 square miles. Elk Creek basin above the damsite is less than ten percent of the total contributing area, but it includes some of the highest elevation headwaters and would be expected to have a greater proportional effect on streamflow generation. The other major headwaters are upper Pass Creek and tributaries of upper Elk Creek that will not be blocked by MTH Dam, which each cover a similar percentage of the basin and have similar elevations as the area above the dam. The total contributing area to the mainstem of Elk Creek increases rapidly with increased distance downstream of the damsite; particularly downstream of Scotts Valley where Yoncalla and Pass Creek enter the river (Trihey 1997).

   Mean monthly time series hydrographs and monthly exceedance curves for the with- and without-project conditions (Douglas County PWD, 1990; cited in Trihey 1997) indicate that the major effects of the proposed project are decreases in mean monthly flows from December through March of most years and an increase in mean monthly flows during the naturally dry months of June through September in all years. For regularly occurring flows (50 to 100% exceedance), Trihey (1997) concluded that "the effect is primarily a seasonal redistribution of flows and probably not a dramatic change in total transport capacity." Examples of the predicted average monthly peak flow reductions for the high water months of December through March are given in Table 1, and for the low water months of July through October in Table 2, below for a variety of water years at the damsite and at Boswell Springs (13 miles below the damsite).

Table 1. Peak flow reductions due to MTH Dam at the damsite (RM 39.4) and at Boswell Springs (RM 26.2) on Elk Creek based on data generated by the Milltown Hill simulated flow model and presented in USDI (1997a, p.43-44). Pre- and post-project average monthly flows are given **for the high water months of Dec-Mar** for 1956 (highest water year on record), 1977 (lowest water year on record), 1930, and 1973 (intermediate water years).

Year	MTH Damsite			Boswell Springs		
	Pre-project monthly ave. flows (cfs)	Post-project monthly ave. flows (cfs)	reduction in flows due to MTH dam	Pre-project monthly ave. flows (cfs)	Post-project monthly ave. flows (cfs)	reduction in flows due to MTH dam
1956	269.0	227.8	15%	1,020.9	979.6	4%
1977	17.4	5.3	70%	65.9	53.8	18%
1930	84.0	5.0	94%	319.0	237.4	26%
1973	67.6	5.0	93%	256.4	193.9	24%

Table 2. Base flow increases due to MTH Dam at the damsite (RM 39.4) and at Boswell Springs (RM 26.2) on Elk Creek based on data generated by the Milltown Hill simulated flow model and presented in USDI (1997a, p.43-44). Pre- and post-project average monthly flows are given **for the low water months of Jul-Oct** for 1956 (highest water year on record), 1977 (lowest water year on record), 1930, and 1973 (intermediate water years).

Year	MTH Damsite			Boswell Springs		
	Pre-project monthly ave. flows (cfs)	Post-project monthly ave. flows (cfs)	increase in flows due to MTH dam	Pre-project monthly ave. flows (cfs)	Post-project monthly ave. flows (cfs)	increase in flows due to MTH dam
1956	3.2	29.5	9x	12.1	41.0	3x
1977	0.8	16.5	21x	3.0	18.5	6x
1930	0.9	30.6	34x	3.4	38.8	11x
1973	0.7	32.2	46x	2.6	38.8	15x

Since the channel is not highly adjustable, Trihey (1997) also looked at project effects on the 1 to 25 % exceedance mean monthly flows for the winter months at the damsite. The project will cause a relatively large reduction in high flows during November, but only a small change in the larger magnitude flows occurring in the months of December to March. In general, project effects on winter mean monthly flows are small, and are more distinct at the damsite than at any of the other control points further downstream. Over the modeled study period (1925-1990) the project does not have any noticeable effect on mean monthly flows that are greater than about 80-100 cfs (see Table 1 above). This suggests that the change in sediment transport during flood events will be minor, even at the damsite. The project's increase in mean low flows, while important from an ecological point of view, is not likely to affect sediment transport capacity or channel forming processes.

3. Conclusion. Based on the available information, NMFS concludes that the proposed MTH project will primarily affect the streambed composition between the damsite and Adams Creek by resulting in a loss of finer material overlying the bedrock and boulder substrate. Trihey (1997) was not able to define the magnitude of this change from the available data, since the relative importance of the transported sediment from upstream and the local streambanks is uncertain. However, he did not expect the change to be large relative to existing conditions because the existing transport capacity between the dam and Adams Creek appears to be so large that few gravels or smaller particles are currently deposited. Downstream of Adams Creek, NMFS agrees with Trihey's conclusion that "Based on our present understanding of the existing channel geometry, the relative sub-basin contributions to hydrology and sediment supply and our knowledge of the with-project hydrology, we believe that it is most unlikely that the incremental effects of the proposed project on channel conditions downstream of Adams

Creek could be discerned from the cumulative effects of natural hydrology, sediment supply, and land use practices in other sub-basins."

A commonly attempted solution to poor channel conditions such as the ones noted in Elk Creek (e.g., lack of structure and spawning gravel) is instream restoration through re-engineering the channel (which is being proposed for the MTH project - see "6. Mitigation" below). A more effective approach (because it addresses the underlying physical causes of the problems) may be to attempt to maintain or regain the natural morphology of the stream below the dam by managing water releases and sediment in ways that preserve natural geomorphic processes. This approach has evolved into the channel, floodplain, and valley maintenance flow concepts, which attempt to find a generalized procedure for deriving flow schedules for regulated rivers that will serve to maintain geomorphic processes (Hill et al., 1991; Beschta and Platts, 1986). However, based on the analysis discussed above, NMFS does not believe that channel maintenance flows are necessary at the MTH project because (1) the Elk Creek channel is not highly adjustable, and (2) the project will result in only a small change in the larger magnitude flows occurring in the months of December to March.

b. Alterations in Flow: Effects on UR cutthroat trout. The likely effects of flow alterations due to the MTH project on these UR cutthroat trout are discussed below. Limiting factors are characterized in Elk Creek for these anadromous salmonids, including UR cutthroat trout ("Limiting factors for anadromous salmonid production"), and experience at other dams is discussed ("Comparison to other dams"). The best available information has been used to predict these effects in general terms.

1. <u>Limiting factors for anadromous salmonid production</u>. USDI (1997a) states that, according to resource managers (no source is given), the main limiting factors for UR cutthroat trout, coho and steelhead in the Elk Creek subbasin are (1) high water temperatures, (2) lower summer flows, (3) flooding, (4) siltation, (5) lack of habitat complexity, such as large woody debris (LWD), and (6) lack of gravel. They summarize the MTH project features that are designed to ameliorate the flow- and temperature-related limiting factors as follows:

! *Augmentation of Summer Low Flows* - Flows in Elk Creek typically drop to less than 1 cfs during summer under existing conditions, but the project will provide the capability to maintain flows in the 39.4 miles of lower Elk Creek in excess of 35 cfs July through September in 90% of all years. Similarly, flows in the lower 2.5 miles of Yoncalla Creek will be increased from less than 1 cfs presently, to 5 cfs through the summer.

! *Reduction of Flood Flows* - The reservoir will have the capacity to sharply reduce peak flows in the fall and early winter. There are 18,388 acre-ft of active storage that will be withdrawn each summer and refilled each winter.

! *Reduction of Summer Water Temperatures* - Water temperatures that typically average in the upper 60's F° at Drain, 13 miles downstream of the project, are projected to remain near 55/F through the summer. The dam will have a fixed deep outlet and an adjustable (42 ft range) surface outlet that enable control of release temperatures.

USDI's (1997a) statement that high water temperatures and low flows are limiting anadromous salmonid production in Elk Creek is supported by USDI's (1996b, p.7-2) conclusion that "In the larger stream reaches such as lower Elk Creek, temperature and low water appear to be limiting factors in at least some years." Flow and water temperature permitting, these lower reaches would probably be extensively used throughout the summer by anadromous cutthroat parr (see "UR Cutthroat Life History" above) as well as juvenile steelhead and coho. However, for UR cutthroat trout, which make greater use of the upper mainstem and tributaries than the lower mainstem for spawning and initial rearing, other limiting factors are probably also important during these life history stages. For example, USDI (1996b, p.7-2) states, "In most cases in the East Elk WAU [watershed analysis unit] lack of LWD [large woody debris] and excessive sediment seem to be the limiting factors" for fish populations (see "4. Change in Sediment Transport and Storage", and "6. Mitigation" below for discussion of how the MTH project addresses these limiting factors).

As explained above, NMFS does not agree that flood flows are necessarily a limiting factor in the mainstem of Elk Creek, and considers this aspect of the project a potential detriment to fish, not a benefit. However, NMFS agrees that summertime low flows and high water temperatures are among several limiting factors for anadromous salmonids in the mainstem of Elk Creek, and that the proposed operation of MTH Dam would ameliorate these limiting factors, resulting in increased anadromous salmonid rearing habitat.

2. Comparison to other dams. Research on the response of aquatic habitat and anadromous salmonid populations to existing dams may be instructive in determining the effects of the MTH project. The most relevant existing dam for this is the Galesville project on Cow Creek (primary tributary of the South Umpqua River) as it is of similar size, design, and operation to the proposed MTH project, and it was also built and is operated by Douglas County. Douglas County is preparing a report on the effects of this project on anadromous salmonids and their habitat in Cow Creek that will give a more detailed analysis than provided below (Douglas County, in preparation). Also, the effects of Lost Creek and Applegate Dams on the Rogue River system on steelhead and fall chinook have been studied by ODFW for several years and provide another example.

Galesville Dam. Galesville Dam is located at river mile 60.5 on Cow Creek, the major tributary of the South Umpqua River. Douglas County began operation of Galesville Dam in 1987 (water storage began in fall of 1985), and the project is used to augment summer flows in Cow Creek similar to the proposed operation of MTH Dam. Stream temperatures compared before and after completion of the dam show that mean monthly temperature at Azalea (two miles below the project) has been more than 15/F cooler in July and August after the dam was completed. However, no change in mean July and August temperatures is apparent 53 miles downstream at Riddle. Summer temperatures now remain within the tolerable range for juvenile salmonids for about 20 miles downstream from the dam to McCullough Creek, and are 1-3/F cooler there now than before the dam was built (USDI 1997b).

In the autumn, water released from Galesville Dam is now warmer than it was without the dam. Mean stream temperatures at Azalea are about 5/F warmer in October and November and 2.5/F warmer in December than before dam completion. The post-dam temperatures during October-December at Azalea are similar to the predam temperatures 52 miles downstream at Riddle. However, there is no difference before and after the dam in October-December temperatures at Riddle. It is not clear from the available data how far downstream the warming effect extends during October-December (USDI 1997b). Autumn stream temperatures have the potential to influence incubation of chinook and coho eggs. Spawning peaks around the beginning of November for fall chinook and through December for coho, while both steelhead and cutthroat are spring spawners. Coho spawning extends up to the dam, while fall chinook spawning is limited to lower Cow Creek. UR cutthroat trout probably spawn mostly in Cow Creek tributaries, thus the spatial and temporal patterns of spawning minimizes or avoids the influence of changes in fall temperatures released from the dam on cutthroat egg incubation (USDI 1997b).

Riparian vegetation along Cow Creek downstream of the project appears to have improved since the project began operation, apparently because the higher level of the water table during summer now allows the riparian vegetation to survive through the dry season. There has not been any planting of riparian vegetation. Whereas flow frequently dropped to near 10 cfs at Azalea during summer before the dam, flow now remains above 50 cfs until October. In extreme drought years, such as 1977, portions of Cow Creek actually dried up and much riparian vegetation died (USDI 1997b).

Flows out of Galesville Dam generally begin to mimic inflows sometime during November 1 through January 31, because the reservoir rule curve dictates that the pool level may not exceed minimum flood pool. The reservoir is filled during February-April. Only during flood events are inflows stored, in order to keep flows within the bank-full level. Thus, operation of Galesville allows flows up to bank-full level and tries to prevent flows that exceed bank-full levels. The ability of Galesville Dam to prevent flooding is greatly reduced below RM 27 where the West and Middle Forks enter the stream (USDI 1997b).

Lost Creek and Applegate Dams. ODFW's studies of the effects of these two dams (Rogue River system) have failed to detect any statistically significant change in wild production of summer steelhead, the anadromous salmonid species for which data is available that has the most similar life history to UR cutthroat trout. On the Rogue River, the operation of Lost Creek Dam (i.e., higher base flows and lower summertime temperatures) appeared to have minimal effect on the production of summer steelhead, probably because adults spawn in tributaries. No relationship was found between indexes of juvenile abundance and river physical characteristics (Satterthwaite 1994). The steelhead in Elk Creek subbasin are all winter-run, but the results of research on the response of Rogue winter steelhead (some of which spawn in the mainstem) to Lost Creek Dam are less comprehensive than for summer steelhead (Satterthwaite 1990). In the Applegate River, available data are inadequate to determine if the Applegate Dam affected the abundance of adult summer and winter steelhead or changed juvenile rearing distribution (Fustish et al., 1989). Further research on the response of winter steelhead to the Lost Creek and Applegate Dams may show correlations between wild production and the operation of the projects, but data currently available do not demonstrate this.

There are several key differences between the Lost Creek/Applegate projects and the MTH project that should be noted when attempting to make this comparison. First and most importantly, both the Rogue River at Lost Creek and the Applegate River at Applegate Dam had substantial summer flows, tolerable summer temperatures, and large populations of anadromous salmonids before the dams were built (USDI 1997b). In contrast, flows in Elk Creek at the project site and for most of its 40 miles downstream drop below 1 cfs in most summers, and stream temperatures frequently exceed 75/F. Natural summer flows of the Rogue River entering Lost Creek Dam rarely dropped below 1,000 cfs, and mean monthly river temperature rarely exceeded 65/F (Cramer et al., 1985). Natural summer flows of the Applegate River entering Applegate Dam rarely dropped below 50 cfs and daily maximum (not mean) stream temperatures in mid summer averaged near 72/F (Fustish et al. 1988). Flows in the Applegate River 30 miles downstream of the dam were depleted by water diversions upstream, but flows at the damsite were adequate to sustain a large population of steelhead.

Comparison of the watershed sizes also shows the dramatic difference of the Milltown Hill damsite from that of the Lost Creek or Applegate damsites. The watershed area above the Milltown Hill damsite is only 28.7 mi^2, which represents 10% of the Elk Creek subbasin and 0.6% of the Umpqua Basin. The drainage area of the Rogue River above the Lost Creek damsite is 938 mi^2, and the drainage area of the Applegate River above Applegate damsite is 223 mi^2. Both the Lost Creek and Applegate damsites would have been rejected from consideration if they had been selected by the same criteria applied to selecting the MTH damsite (USDI 1997b), as described above in "**V.A. Effects of Proposed Action.** 1. Migration Barrier and Habitat Loss".

c. Alterations in Water Quality. Douglas County has monitored water temperature in Elk Creek for several years with thermographs and spot measurements (USDI 1992). Mean monthly water temperature for July and August from 1987 to 1990 was 16.9°C (62.4°F) at Elkhead (RM 37.5) and

19.2°C (66.6°F) at Boswell Springs (RM 26.5). Water temperatures along the entire length of Elk Creek were measured twice a month from July through September in 1990. The results showed a sharp increase from just below Drain (RM 22.8) downstream to the mouth, when the eight measuring stations in this reach had stream temperatures ranging from 21.1°C (70°F) to 27.8°C (82°F) on July 17, July 31, and August 14 (USDI 1992).

Operation of the dam would result in increased releases of water during summer months, and the effect of these releases on summertime stream temperatures in Elk Creek was modeled as part of the Environmental Impact Statement to predict the expected changes (USDI 1992). Based on the modeling results, stream temperatures would be expected to remain below 65°F between the dam and river mile 10 during summer months when flows are 30 to 40 cfs. A possible exception to this could occur in August during years with prolonged hot weather approaching 100°F, when stream temperatures below river mile 15 may rise to above 65°F (still considerably cooler than without the project). Water quality would be beneficially affected by the release of increased flows of cooler water during summer months. The increased flows would dilute industrial and domestic wastes while the cooler water would retard the growth of undesirable nuisance algae. The cooler water, along with the much greater water volumes, resulting from the increased flows would provide habitat for UR cutthroat trout (and other anadromous salmonids) in the mainstem of Elk Creek that is currently uninhabitable by these species during the summer.

Wintertime water temperatures can be increased below large dams due to heat storage in the reservoir, resulting in disruption of natural anadromous salmonid spawning cycles, as was found to be the case for Lost Creek Dam on the Rogue River (Cramer et al. 1985). The fish negatively affected below Lost Creek Dam were spring chinook that spawned primarily in September. Heat energy stored in Lost Creek Reservoir during summer caused release temperatures to exceed natural and target temperatures during November, December, and January by 2.5/F, 3.1/F, and 1.1/F, respectively (Cramer et al. 1985), when the reservoir became homothermal. This warming accelerated the incubation of spring chinook eggs and resulted in their emergence and average of 52 days earlier after dam closure than before. Water temperatures in Elk Creek below the MTH project will not be increased in the spring due to the project, thus the spring-spawning UR cutthroat trout will not be affected by this phenomenon.

A dramatic physical difference between Lost Creek Dam and Milltown Hill Dam is the ratio of active storage to carryover storage. Lost Creek Reservoir has 180,000 acre-ft of active storage and 285,000 acre-ft of carryover storage, for a ratio of 1 to 1.6. MTH Reservoir has 18,328 acre-ft of active storage and 5,708 acre-ft of carryover storage, for a ratio of 1 to 0.3. Thus, Milltown Hill will have much less heat energy to dissipate during winter. Simulation modeling of temperatures in MTH Reservoir and its outflow indicate that outflow temperature will only exceed inflow temperature during October and possibly early November in most years (compare Tables 5 and 11 of Tanovan 1991). Only coho, and not cutthroat or steelhead, might spawn during this time, but Umpqua Basin coho typically do not begin spawning until early December (Cramer 1994). Thus it is unlikely that the operation of the MTH project will adversely affect spawning or incubation of any anadromous salmonid species due to warming of outflow water in the fall or winter.

Water quality parameters other than temperature also may be affected by the MTH project, such as dissolved oxygen, pH, turbidity, and nutrient availability. For example, the development of an organically rich hypolimnion in new reservoirs has sometimes caused the development of potentially toxic substances such as ammonia and hydrogen sulfide. Korn and Smith (1971) reported that high levels of hydrogen sulfide from the hypolimnion of the newly constructed Fall Creek Reservoir killed several hundred fish downstream of the dam. After preimpoundment accumulations of organic bottom debris decomposed, hypolimnion conditions improved and hydrogen sulfide was no longer produced at such high levels. At the MTH site, these water quality impacts will be minimized by the use of a cone valve to aerate the reservoir outflow, removal of organic debris from the inundation area (except for fish habitat structures and some timber), and minimization of soil disturbance (USDI 1991, p.3-36). In addition, ODEQ's 401 Certification for the project requires burning of the reservoir inundation area before filling to reduce organic matter available for decomposition in the hypolimnion. These measures will reduce, but not eliminate, the potential for water quality problems associated with hypolimnion releases in the summer and fall.

The MTH Dam cone valve will cause water to be sprayed into the air and re-oxygenated as it plunges back to the tailrace. The effectiveness of the cone valve for increasing dissolved oxygen (DO) and eliminating hydrogen sulfide has been demonstrated at other reservoirs, including at Galesville Dam on some occasions. The discharge at Galesville Dam is equipped with a cone valve, but it is generally not used during summer. The outflow from Galesville Dam has encountered low DO in the summer when water was being discharged through the turbines rather than the cone valve. In contrast, all water at MTH Dam will be discharged through the cone valve or over the spillway (there will be no turbines). Before 1993, little attention was paid to DO levels below the Galesville project, and discharges were managed primarily to maximize cooling of water downstream. In 1993, it was discovered that oxygen was depleted in the dam tailrace during late summer, and the problem was resolved by withdrawing a greater proportion of water from higher in the water column (USDI 1997b).

No experiments have been conducted at Galesville Dam to demonstrate the effectiveness of the cone valve at re-oxygenating the water, but some data was collected October 1991 when discharges were directed temporarily through the cone valve on several dates. During that month, water was released from the hypolimnion of Galesville Reservoir at depths of 28 feet and 56 feet below the surface. On days when the power plant was operating and the cone valve was closed, DO concentrations in the tailrace, averaged 5.2 mg/l and ranged from 4.8 to 5.6 mg/l (USGS data). On 8 days of that month (not consecutive), water was discharged through the cone valve for 5.5 to 16.0 hours per day, and DO concentrations averaged 7.2 mg/l and ranged from 6.0 to 8.5 mg/l. The full effect of the cone valve discharge could not be seen, because it was only used during a portion of the day, while DO was reported as a daily average (USDI 1997b).

d. Conclusion. In summary, the flow alterations in Elk Creek due to the proposed MTH project are not likely to significantly affect the physical structure of this channel because (1) the Elk Creek channel is not highly adjustable, and (2) the project will result in only a small change in the larger magnitude flows occurring in the months of December to March (see "a. Alterations in Flow: Effects on stream habitat, 3. Conclusion" above). Because summertime low flows and high water temperatures are among several limiting factors for UR cutthroat trout and other anadromous salmonids in the mainstem of Elk Creek, and the proposed flow augmentation during the summer and early fall would ameliorate these limiting factors, it is likely that this aspect of the proposed operation of the MTH project will result in increased rearing habitat for these species.

4. Change in Sediment Transport and Storage. In addition to flow and water temperature, dams also affect sediment transport. This can have major implications for fish habitat. USDI (1996b, 1997a) identifies excessive fine sediment as a limiting factor for anadromous salmonid production in upper Elk Creek. The BA (USDI 1996a) concludes that the MTH Dam will trap sediment and reduce transport of sediment downstream, providing a potential benefit in the reach immediately downstream of the dam. However, altering the sediment regime can also result in significant adjustments of the channel, depending on the channel's sensitivity (Ligon et al., 1995; Spence et al., 1997).

A high degree of bedrock influence is persistent throughout much of Elk Creek between the damsite and its confluence with the Umpqua River (about 40 miles downstream), thus the Elk Creek mainstem is not a fully adjustable alluvial channel that is primarily shaped by erosion and deposition processes associated with annual floods. Its stream boundaries are primarily formed by materials that are not moved under bankfull flow, although a veneer of cobbles, gravel and sand form a portion of the channel bed materials (Trihey 1997). Therefore, Elk Creek's channel below the damsite would not be expected to be highly sensitive to alterations in the sediment regime of the scale that would occur due to the MTH project.

Based on the percent of area with steep slopes, the geology and the slope hazards above Elkhead Watershed versus the downstream watersheds within the Elk Creek subbasin, Trihey's (1997) preliminary assessment was that total sediment production per unit area is probably lower upstream of the proposed damsite than in some of the other watersheds. However, the production of coarse sands and gravels from areas of Siletz River Volcanics may be relatively high in the Adams Creek Watershed and portions of the area above the dam. There are large areas of steep slopes, weak soils and slope hazards in geologic materials likely to generate fine sediment in the other watersheds. These factors and the small percent of the subbasin above the dam suggest that the proposed impoundment will not eliminate a sediment source of any overriding importance to the channel-building process in mainstem Elk Creek. However, the sediment supply immediately downstream of the dam (between the damsite and Adams Creek) will be reduced by the impoundment (Trihey 1997).

Sediment-related effects of the MTH project that were not considered in the original BA (USDI 1996a) or by USDI (1997a) include the potential increase in sedimentation and turbidity due to (1) conversion of thousands of acres of pasture and other land to irrigated cropland, and (2) irrigation return waters in the Elk Creek subbasin. The MTH project will result in the conversion of up to 4,661 acres of pasture and other land to irrigated cropland (less than 1,600 acres are currently irrigated; USDI 1992). This large-scale conversion of untilled pasture to tilled, irrigated cropland would be a major land use change with the potential to increase sedimentation and turbidity of Elk Creek subbasin streams. These effects are described in "**V.A. Effects of the Proposed Action**, 8. Interrelated and Interdependent Actions" below.

5. Effects of Mercury Bioaccumulation on UR cutthroat trout. This section considers the effects of potential mercury contamination associated with the project on UR cutthroat trout. Mercury has no known biological function and the presence of the metal in the cells of living organisms is considered undesirable and potentially hazardous. In natural aquatic environments, mercury occurs primarily in three forms; elemental mercury, inorganic mercury, and methylmercury. Most mercury is released into the environment as inorganic mercury, which is primarily bound to particulates and organic substances and is not readily available for direct uptake by aquatic organisms. The process of methylation converts inorganic mercury to methylmercury, which is readily available for direct uptake by aquatic organisms. Methylation is influenced by environmental variables such as dissolved oxygen, pH, salinity, and many others (Beckvar et al., 1996). Mercury can be bioconcentrated in aquatic organisms and biomagnified through food chains, and it is known to cause a wide variety of acute and chronic effects. Use of mercury should be curtailed, as the difference between tolerable natural background levels of mercury and harmful effects in the environment is exceptionally small (Eisler 1987). The proposed MTH project is located within a mercury deposit (Curtis and Allen-Gil, 1994), and an abandoned mercury mine (Elkhead Mine) is located 500 feet upslope from the project's inundation area.

The BA (USDI 1996a) states that "[a] survey of the abandoned mercury mine, tailings, and water sources in and near the mine indicates small potential for contamination" (USDI 1996a). This is apparently a reference to CH_2M Hill (1995). The objective of CH_2M Hill's investigation and subsequent 1995 report was to respond to the Oregon Department of Environmental Quality's (ODEQ) concern that mercury contamination at the proposed MTH project could violate State Law OAR 340-41-285. The law states that "[t]oxic substances shall not be introduced above natural background levels in the waters of the state in amounts, concentrations, or combinations which may be harmful, may chemically change to harmful forms in the environment, or may bioaccumulate to levels that adversely affect public health, safety, or welfare; **aquatic life**; or other designated beneficial uses." (ODEQ 1993, emphasis added). CH_2M Hill's (1995) conclusion that "mercury is not expected to pose a foodchain threat once the reservoir is completed" (CH_2M Hill 1995, p.ES-3) is the applicant's response to ODEQ's concern. Since this sweeping conclusion applies to all aquatic life in the project area, including UR cutthroat trout, NMFS evaluated CH_2M Hill (1995) as the first step in the analysis of mercury effects of MTH on UR cutthroat trout (see Attachment 3).

In determining the likely mercury effects on UR cutthroat trout from the construction and operation of MTH Dam, NMFS used the best available information, including data collected by CH_2M Hill (1995), comparison with mercury-related data collected from Cottage Grove Reservoir watershed (upper Willamette basin), the scientific literature, and personal communication with scientists who have worked in the area. This component of the "Effects of the Action" section of the opinion is organized as follows: (a) Waterborne Mercury at MTH Site, (b) Sediment Mercury at MTH Site, © Fish Tissue Mercury at MTH Site, (d) Comparison With Cottage Grove Reservoir Watershed, and (e) Conclusions. All mercury concentrations cited from CH_2M Hill (1995) are for total mercury. A source of confusion in contaminants analyses is the variety of units used to express concentrations, and those which were encountered in the literature reviewed for this analysis are given in Table 3 below. Note that there are two metric unit measurements included in the table for unit mass that are both equal to parts per million (mg/kg and µg/g). In this report, all waterborne mercury concentrations are given in nanograms per liter (ng/l, equal to parts per trillion), and all sediment and fish mercury concentrations are given in micrograms per gram (µg/g, equal to parts per million).

Table 3. Concentration units (equivalents for metric and "parts per" units).

	Metric units		"Parts per" units
Unit volume	milligrams/liter (mg/l)	=	parts per million (ppm)
	micrograms/liter (µg/l)	=	parts per billion (ppb)
	nanograms/liter (ng/l)	=	parts per trillion (ppt)
Unit mass	milligrams/kilogram (mg/kg)	=	parts per million (ppm)
	micrograms/gram (µg/g)	=	parts per million (ppm)
	micrograms/kilogram (µg/kg)	=	parts per billion (ppb)

The following thresholds may be helpful in evaluating the data described below. For waterborne mercury, the Federal Criterion Continuous Concentration (CCC) in freshwater is 12 ng/l (60 CFR 22232; May 4, 1995). CCC is defined as "the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects." Impaired reproduction in sensitive aquatic organisms, such as rainbow trout, has been shown to occur at water mercury concentrations between 30 and 1600 ng/l (Eisler 1987). For sediment mercury, there do not appear to be any thresholds in common use. However, Birge et al. (1977) reported that rainbow trout eggs incubated and hatched in sediment with 0.180 µg Hg/g (inorganic mercury) resulted in 19% mortality at hatching and 30% mortality 10 days after hatching (a control group of eggs incubated in sediment with 0.052 µg/g had 5% mortality at hatching and 6% mortality 10 days after hatching). For fish tissue mercury, Niimi and Kissoon (1994, cited in Beckvar et al., 1996) suggest that a total mercury body burden of 1-5 µg/g wet weight represents a threshold concentration for chronic adverse effects in aquatic organisms, including rainbow trout. These thresholds should be used with caution because lower concentrations may still affect behavior and reproduction, although not as dramatically or quickly as the higher concentrations.

a. Waterborne Mercury at MTH Site

1. Current waterborne mercury at MTH site. Water samples were taken from 10 locations by CH_2M Hill (1995) from streams in the MTH project area (including upper Elk Creek, Walker Creek, and Lane Creek) during both low and high flows, and tested for mercury content. Low flow mercury concentrations ranged from 0.75 to 3.23 ng/l with an average of 1.77 ng/l, while high flow mercury concentrations ranged from 3.52 ng/l to 26.1 ng/l with an average of 7.03 ng/l (CH_2M Hill 1995, p.2-19,20). The high concentration of 26.1 ng/l was detected at the same Lane Creek unnamed tributary that had the highest mercury sediment concentrations. Further testing by CH_2M Hill (1995) of this stream during the same month that the initial high flow mercury water concentration samples were taken (12/94) resulted in a much higher mercury concentration (66.98 ng/l), and mercury concentrations of 25.74 to 262.8 ng/l from its tributaries.

2. Post-project waterborne mercury at MTH site. No change in waterborne mercury would be expected in the tributaries due to the MTH project because the project would have no effect on these tributaries. CH_2M Hill (1995) attempted to model mercury cycling in MTH reservoir but inadequate data and inappropriate assumptions resulted in questionable results (see "Mercury Cycling Model" in Attachment 3). Mercury methylation is usually greatest at the sediment-water interface, but also occurs in the water column. Methylation is influenced by a large number of factors (Beckvar et al., 1996) and is generally enhanced by conditions created in a newly flooded reservoir (Wiener and Spry, 1996). Thus waterborne mercury within the MTH reservoir is likely to be higher than the average waterborne mercury CH_2M Hill (1995) found in the streams within the MTH project area (low flow average of 1.77 ng/l and high flow average of 7.03 ng/l, from CH_2M Hill 1995, pp. 2-19 - 2-20).

b. Sediment Mercury at MTH Site

1. Current sediment mercury at MTH site. Sediment samples were taken by CH_2M Hill (1995) from streams (both within and above the area that would be inundated by the reservoir, hereafter referred to as the "inundation area") in the MTH project area and tested for mercury content. Average mercury concentration for the entire area was 0.205 µg/g (±0.197, 95% confidence interval [CI]), and µg/g 0.240 (±0.155, 95% CI) for samples taken only from within the inundation area. The two samples with the highest mercury content (2.13 and 0.78 µg/g) were from the unnamed tributary of Lane Creek nearest the abandoned Elkhead Mine and Thompson Prospect (east side of inundation area - see Fig.5, p.2-15, in CH_2M Hill 1995).

2. Post-project sediment mercury at MTH site. No change in sediment mercury would be expected in the tributaries due to the MTH project because the project would have no effect on these tributaries. Within the inundation area, however, sediment mercury could increase due to (1) mercury methylation, and (2) sediment mobilization and accumulation. CH_2M Hill (1995) attempted to model mercury cycling in MTH reservoir but inadequate data and inappropriate assumptions resulted in questionable results (see "Mercury Cycling Model" in Attachment 3). Mercury methylation is usually greatest at the sediment-water interface. The primary methylators of mercury in sediments are anaerobic, sulfate-reducing bacteria. Methylation rates in sediments are affected by the complex interaction of many factors such as oxygen concentration, pH, season, and many others (Beckvar et al., 1996). Thus the mercury sediment concentration is generally not an accurate predictor of methylmercury concentration. However, mercury methylation in the sediments of a new reservoir is generally relatively high due to the inorganic mercury present in the inundated terrestrial habitats. Mercury sediment concentrations typically increase after filling (Wiener and Spry, 1996).

   The MTH project will result in sediment accumulation behind the dam, along with any associated mercury. The operation of the proposed MTH project is typical of water supply or flood control dams in that it would be characterized by annual water storage and drawdown. This is likely to result in mobilization and movement of sediments downstream of the point-source throughout the inundation area as well as downstream of the dam. At the similarly operated Cottage Grove Reservoir, sediments from the confluence of the Coast Fork Willamette River with the reservoir contained 0.83 µg Hg/g, by far the most mercury of any tributary to this reservoir. But between the confluence of the Coast Fork and the dam, mercury concentrations in reservoir sediments increased from 0.35 µg/g closest to the confluence to 1.11 µg/g closest to the dam. Furthermore, sediments downstream of the dam had more than twice as much mercury (1.75 µg/g) as at the confluence of the Coast Fork of the Willamette River with Cottage Grove Reservoir (0.83 µg/g) (Park and Curtis, 1997). Mercury-laden sediment transport appears to be taking place during annual drawdowns, and probably also while the reservoir substrate is exposed during heavy rains.

Drawdown of the MTH reservoir also has the potential to distribute sediments throughout most of the reservoir because stream sediments with the highest mercury are found within, and are upstream of, the inundation area. In addition, a road surface sampled within the inundation area had a mercury concentration of 1.17 µg/g, while another sample only 100 feet from the inundation area had a very high mercury concentration of 9.82 µg/g (CH_2M Hill 1995, 2-10). This road leads downhill from the 9.82 µg/g sample site directly into the inundation area, and sediment transport during heavy rains could result in a significant amount of mercury-laden sediment eroding into the reservoir. CH_2M Hill (1995) notes that mercury migration from the point source in the MTH area (i.e., Elkhead Mine) down Elk Creek does not appear to have occurred. However, the radically altered conditions within the inundation area could result in significantly increased mercury for the reasons stated above. Mercury movement during drawdowns is likely to be facilitated by the transformation of the current relatively complex terrestrial habitat within the inundation area to the bare surface typical of reservoir substrates. Therefore, due to both enhanced methylation in a newly inundated environment and the mobilization and accumulation of sediments, it is likely that the sediment mercury within the MTH reservoir, as well as downstream of the dam, will be higher than the average sediment mercury CH_2M Hill (1995) found in stream sediments within the inundation area (0.240 µg/g, from CH_2M Hill, p.2-2) unless measures are taken to minimize movement of mercury-laden sediment into the inundation area.

3. Erosion control measures for Elkhead Mine. In BOR's amendment to the BA (USDI 1997b), the following measures were proposed for controlling erosion at Elkhead Mine:

> "Douglas County shall provide erosion control measures to minimize down-slope transport of mercury in the vicinity of the Elkhead Mercury Mine where soil concentrations of mercury exceed 1 ppm. The plan for these measures shall be designed by qualified experts independent from the County, such as the US Natural Resources Conservation Service or private consultant. These measures are likely to include restriction of livestock from use of the area, planting of vegetation in exposed areas, and construction of a trench to retain runoff below the mine area. The measures must be satisfactory to fulfill the requirements of the issued 401 Clean Water Certification by Oregon Department of Environmental Quality and the US Environmental Protection Agency.
>
> Items the County shall do:
>
> a. The road system in the Elkhead Mine vicinity will be constructed, or modified, to allow containment of runoff and sediment prior to entering the reservoir. Culverts in this area will be constructed with small retaining ponds to allow sediments to settle in an area which County road crews can clean as occasion demands. This sediment will be transferred to a sanitary landfill.

b. The County will enter into a binding “land management practices” agreement with the landowners of the claim area in sections 21 and 22 which will provide the maximum assurance of reducing silt runoff from the land. The envisioned practices may include such items as:

1. Limiting the amount of stock/acre.
2. Dictating the specific vegetation planted.
3. Place restrictions on the use of the land.
4. Adopting Best Management Practices for the lands in question.

Land management practices specified in the agreement will be developed either by the Natural Resources Conservation Service or a private consultant, or both. If a suitable arrangement cannot be reached with the landowner(s), the County may be required to purchase sufficient property to insure compliance with the 0401 certification requirements.” (from USDI 1997b, p.29-31).

These proposed measures, if better defined and strictly implemented, have the potential to reduce erosion of sediment mercury from Elkhead Mine. This may prevent sediment mercury in the MTH project inundation area becoming higher than the average sediment mercury CH_2M Hill (1995) found in stream sediments within the inundation area (0.240 µg/g, from CH_2M Hill, p.2-2).

c. Fish Tissue Mercury at MTH Site

1. <u>Current fish tissue mercury at MTH site</u>. Craven (1993) found whole body mercury concentrations in two cutthroat trout sampled from Elk Creek (one sample each from below damsite and above Lane Creek) to be <0.20 µg/g. CH_2M Hill (1995) found whole body mercury concentrations in two rainbow trout sampled from Elk Creek at the MTH damsite to be <0.045 µg/g. No trout were sampled for mercury tissue concentrations from the Lane Creek unnamed tributary (where the high mercury sediment and water samples were taken), Lane Creek, or between the confluence of Lane Creek with Elk Creek and the damsite. However, seven sculpins and one juvenile coho salmon were sampled from Elk Creek approximately one mile below where the high mercury sediment and water samples were taken from the unnamed Lane Creek tributary (i.e., where transect D crosses Elk Creek, see CH_2M Hill 1995, p.2-3). Two of the sculpins were 4+ years of age and had an average whole body mercury concentration of 0.215 µg/g. The other five sculpins were 2+ or 3+ and had an average of 0.150 µg/g, and the coho had a mercury concentration of 0.060 µg/g (CH_2M Hill 1995, p.2-27) .

   Matida et al. (1971, cited in Wiener and Spry, 1996) found whole body mercury concentrations in rainbow trout to be less than axial muscle concentrations (axial muscle and lateral muscle both refer to skeletal muscle). This is consistent with McKim et al.'s (1976, cited in Wiener and Spry, 1996) findings in brook trout exposed to three different levels of mercury (mercury concentrations were lower in whole body than axial muscle samples, except when waterborne mercury concentrations were extremely high). Thus the lateral muscle mercury concentrations in CH_2M Hill's (1995) Elk Creek rainbow trout samples may have been higher than the whole body mercury concentrations that were tested for and reported. This is an important detail to note when comparing mercury concentrations from whole body samples with samples from a specific tissue (e.g., muscle, brain, and/or gonad samples are often tested rather than whole body samples).

2. Post-project fish tissue mercury at MTH site. No change in fish tissue mercury would be expected in fish that exclusively occur in the tributaries because the project would have no effect on these tributaries. For fish occurring in the reservoir, however, fish tissue mercury could increase due to (1) increased inorganic mercury concentrations in water and sediments in the reservoir, (2) increased methylmercury due to higher rates of mercury methylation within the reservoir, and (3) increased size, age, and piscivorousness of fish as they adapt to the new reservoir environment (all three factors correlate with higher mercury uptake, Beckvar et al. 1996). CH_2M Hill (1995) attempted to model mercury cycling in MTH reservoir and extrapolate expected mercury concentrations in piscivorous fishes inhabiting the reservoir, but inadequate data and inappropriate assumptions resulted in questionable results (see "Mercury Cycling Model" in Attachment 3).

For fish occurring downstream of the dam, fish tissue mercury could increase due to increased mercury concentrations in water and sediments (inorganic mercury and methylmercury) in Elk Creek due to downstream transport from the reservoir. Even at sites where mercury sources occur upstream of a dam, elevated sediment and fish tissue mercury concentrations have been found downstream of the dam. For example, sediments downstream of Cottage Grove Dam had more than twice as much mercury (1.75 µg/g) as at the confluence of the stream coming from the mercury point-source (Coast Fork of the Willamette River) with the reservoir (0.83 µg/g) (Park and Curtis, 1997). Lahontan Reservoir, Nevada, is below the mercury point-source in the Carson River watershed, yet Ekechukwu (1976, cited in Cooper 1983) found mercury levels in common carp to be two to four times as high in the river downstream of the river than Cooper (1983) found in the same species within the reservoir (which also had elevated mercury concentrations). Likewise, Verdon et al. (1991) found that fish tissue mercury increased several fold in the La Grande Hydroelectric Complex area in Quebec, Canada, after construction of the project, with the highest increases being found in fish below the project. The common perception that reservoirs act as contaminant sinks does not appear to hold true for mercury at these projects, nor should it be assumed that this will be the case at MTH dam.

d. Comparison with Cottage Grove Reservoir Watershed

Mercury contamination of Cottage Grove Reservoir (CGR) has resulted in elevated mercury loads in fish inhabiting this reservoir. Average total mercury concentrations in CGR largemouth bass (3+ or older) lateral muscle tissue were reported by Worcester (1979) to be 0.74 µg/g (n=4, range = 0.37 to1.07 µg/g), and by Curtis and Allen-Gil (1994) to be 0.71 µg/g (n=10, range = 0.22 to 1.79 µg/g). The mercury contamination of CGR provides a reference case that may be useful for comparison to MTH due to (1) close location (. 25 km) with similar geology, elevation, size, and management (i.e., annual drawdowns), (2) similar native fish fauna, and (3) point-source mercury contamination (Worcester 1979; Curtis and Allen-Gil 1994; Nielsen et al., 1995; Seim and Park, 1996; Park and Curtis, 1997). Mercury stream sediment concentrations in the streams nearest the mines in each area have been shown to be similar; Dennis Creek near the Black Butte Mine had 3 µg/g (the mercury point-source for CGR; Seim and Park, 1996), and the unnamed Lane Creek tributary near Elkhead Mine had 2.13 µg/g (the primary mercury point-source for MTH, CH_2M Hill 1995).

A comparison of Black Butte and Elkhead Mines was done by Nielsen et al. (1995), who pointed out the following differences between the two sites; “The Black Butte Mine was considerably larger (>10-fold) and more productive (>35-fold) than Elkhead Mine. In addition, Black Butte Mine operated for many years (until about 1967) after Cottage Grove Reservoir was built (constructed in 1943), whereas Elkhead Mine ceased operation in the early 1970s. Most notably, the sediment concentrations indicate extensive mercury migration from Black Butte Mine into Dennis Creek (3.0 µg/g), into the Coast Fork Willamette just after Dennis Creek (1.3 µg/g), and into the Coast Fork of the Willamette just prior to emptying into Cottage Grove Reservoir (0.83 µg/g) over 7 miles downstream (Park and Curtis, communication to the Mercury Working Group, December 1994). The current investigation of the Milltown Hill site revealed that, while some elevated mercury occurred in the unnamed creek flowing into Lane Creek, there was little or no migration of sediment-laden mercury from Lane Creek into Elk Creek, less than ¼ mile from Elkhead Mine.” The “current investigation” cited by Nielsen et al. (1995) was CH_2M Hill’s (1995) study, which found a sediment mercury concentration of 2.13 µg/g at the approximate future confluence point of Lane Creek with MTH Reservoir at full pool and 0.090 µg/g about ½ mile below that point in Elk Creek.

Due to the differences between the MTH/Elkhead Mine and CGR/Black Butte Mine sites, as described above, and the lack of pre-project fish tissue mercury concentration data from the CGR site (with which to compare current CGR fish tissue mercury concentrations), it is not possible to determine if the existing information on current CGR fish tissue mercury concentrations is representative of what might be expected in future fish populations at the MTH site. Fish tissue mercury concentration data collected by Worcester (1979) from rainbow trout inhabiting CGR cannot be used in attempting a comparison because these are likely to have been hatchery fish stocked at catchable size (D. Loomis, ODFW, pers. comm.), and thus only exposed to environmental mercury for a limited amount of time.

Although there are significant differences between the MTH/Elkhead Mine and CGR/Black Butte Mine sites, there are similarities that are cause for concern (1) the elevated stream sediment mercury concentrations (2.13 µg/g) found in the unnamed tributary of Lane Creek within the Elkhead Mine drainage area in the MTH area are similar to mercury concentrations found in Dennis Creek (3 µg/g) near Black Butte Mine above CGR, and higher than mercury concentrations found in the Coast Fork of the Willamette River ¼ mile downstream from the confluence of Dennis Creek (1.3 µg/g) (Seim and Park, 1996), and (2) some of the elevated stream sediment mercury concentrations from the MTH area were found within the inundation area of the future MTH reservoir and are similar to mercury concentrations found by Seim and Park (1996) in CGR sediments.

In his analysis of mercury risk to fish due to the MTH project, Curtis (1997) also compared this site to CGR, and stated that "The potential impact of Elkhead Mine as a mercury point source for the proposed reservoir appears of much less magnitude than that of Black Butte Mine on Cottage Grove Reservoir." His rationale was based primarily on the relatively small mercury production of Elkhead Mine, as well as the short distance that mercury-laden sediment has traveled from the site downslope and downstream. Curtis (1997) concludes that "It is therefore unlikely sediment mercury contamination of the proposed reservoir would approach that of Cottage Grove Reservoir." He goes on to point out that risks of mercury contamination can be reduced by taking steps to stop downslope transport of contaminated soils and tailings from the Elkhead Mine site to the tributary streams and inundations zone.

e. Conclusions

Because the proposed MTH dam does not include fish passage, it would be a total fish barrier, and the UR cutthroat trout trapped above the dam would not have access to the sea. The final rule listing UR cutthroat trout as endangered defined this ESU as including all cutthroat trout in the Umpqua Basin below permanent natural barriers, including resident fish (61 FR 41514; August 9, 1996). Thus UR cutthroat trout trapped above MTH Dam but below natural barriers are included in the ESU, and are protected by the ESA. As a result, this analysis includes UR cutthroat trout populations both above and below the dam. With that in mind, NMFS examined mercury effects on three populations of UR cutthroat trout separately because each population would (1) occur in different habitat relative to the MTH Dam, and (2) have significantly different life histories and ranges which could result in varying exposures to mercury. These three populations of UR cutthroat trout are: (1) trout above the dam but below natural barriers that will be restricted to tributaries of the proposed reservoir for their entire life cycles (resident fluvial), (2) trout above the dam that will inhabit the proposed reservoir (resident lacustrine), and (3) trout below the dam (potentially anadromous). This section is divided accordingly, as follows: (1) mercury effects on cutthroat trout and other anadromous salmonids, (2) mercury effects of MTH project on resident fluvial UR cutthroat trout, (3) mercury effects of MTH project on resident lacustrine UR cutthroat trout, (4) mercury effects of MTH project on potentially anadromous UR cutthroat trout, and (5) summary of MTH project's mercury effects on UR cutthroat trout.

1. Mercury effects on cutthroat trout and other anadromous salmonids. Very little information exists on the effects of mercury on any Pacific anadromous salmonid except the resident form of steelhead (i.e., rainbow trout), thus it was assumed that mercury affects UR cutthroat trout similarly to this closely related species. Effects of mercury in water, sediment, and fish tissue on rainbow trout, as reported in the scientific literature, are given below.

Water. Impaired reproduction in sensitive aquatic organisms, such as rainbow trout, has been shown to occur between 30 and 1600 ng/l (Eisler 1987). The highest water mercury concentration found by CH_2M Hill at the MTH project site was 66.98 ng/l in a Lane Creek unnamed tributary and 262.8 ng/l in one of its tributaries. EPA (1980) reported reduced growth of sensitive species of aquatic organisms at mercury water concentrations of 40 to 1000 ng/l. Rainbow trout was the most sensitive species tested, and growth reduction was observed after 64 days in 40 ng/l as methylmercury (EPA 1980, cited in Eisler 1987, p.59). The Federal Criterion Continuous Concentration (CCC) for mercury in freshwater is 12 ng/l (60 CFR 22232; May 4, 1995). CCC is defined as "the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects." The values and ranges given above should be interpreted with caution since water quality parameters (e.g., pH) can substantially influence the effect of a given mercury concentration on sensitive aquatic species.

Relatively low concentrations of waterborne mercury can be rapidly concentrated (bioconcentration) by aquatic organisms. The relationship of the waterborne mercury concentration vs. the tissue mercury concentration is know as the bioconcentration factor (BCF - the concentration of mercury in tissue divided by the concentration in the exposure water). Birge et al. (1977) found that rainbow trout embryos and larvae exposed to 6,400 ng Hg/l (6.4 ppb) in a continuous flow system concentrated tissue mercury to 902 ppb in 20 days (BCF = 141). McKim et al. (1976) exposed brook trout to varying concentrations of methylmercury for up to 270 days, resulting in BCFs of 69,000 to 630,000. Caution should be used when interpreting BCFs because (1) laboratory studies done before the use of trace-metal free protocols and with higher mercury concentrations found in the field often underestimated BCFs by one or two orders of magnitude, (2) BCFs only reflect uptake of a contaminant from the water, but higher trophic species accumulate mercury primarily through the food web, (3) reported BCFs for mercury vary considerably due to differences between species, exposure concentration, duration, and type of tissue, and (4) BCFs for the same species may be several orders of magnitude higher for methylmercury than for inorganic mercury (Beckvar et al., 1996).

McKim et al. (1976) exposed three generations of brook trout to waterborne methylmercury. Significant mortality of first generation fish occurred after 16-28 weeks exposure to water containing 2,930 ng/l methylmercury, and mortality of second generation fish occurred after 64-100 weeks of exposure to 900 ng/l. There were signs of impaired reproduction in first generation fish and complete reproductive failure in second generation fish exposed to 900 ng/l methylmercury. Exposure to 290 ng/l methylmercury to three generations over the 144-week period resulted in no significant toxicity. As expected from results of 290 ng/l exposures, fish exposed to 90 ng/l methylmercury did not show any signs of toxicity (McKim et al. 1976). The mercury concentration in the tissues of fish exposed to these different levels of waterborne mercury is discussed in the "Fish tissue" section below.

Sediment. There are many examples of fish with elevated mercury tissue concentrations or mercury-induced adverse effects inhabiting waters with mercury sediment concentrations lower than at the MTH site. Abernathy and Cumbie (1977) found that largemouth bass had mercury concentrations of 1.87 to 4.49 µg/g while sediment mercury concentration was only 0.082 µg/g (one-third the average MTH mercury sediment level of 0.24 µg/g within the inundation area) at Lake Jocassee, South Carolina. Park and Curtis (1997) reported a sediment mercury concentration of 0.12 µg/g in Dorena Reservoir where fish tissue mercury concentrations average 0.37 µg/g (Gilroy et al., 1996).

Jernelov (1970) showed that fish exposed to high levels of inorganic mercury in sediment quickly accumulated methylmercury in their tissues. Birge et al. (1977) reported that rainbow trout eggs incubated and hatched in sediment with 0.180 µg Hg/g (inorganic mercury) resulted in 19% mortality at hatching and 30% mortality 10 days after hatching (a control group of eggs incubated in sediment with 0.052 µg/g had 5% mortality at hatching and 6% mortality 10 days after hatching). Birge et al. (1984, p.20) state, "it is possible that early life stages represent one of the most sensitive target sites for sediment-released chemicals on epibenthic species, especially those that spawn directly upon or close to bottom sediments," such as anadromous salmonids.

Fish tissue. Few studies report both tissue residues and effects in either short- or long-term exposure to low concentrations of mercury (Beckvar et al., 1996). The central nervous system, rather than muscle tissue or other organs, is the site of the most harmful toxic action in fish exposed to mercury. Defining critical tissue concentrations for adult freshwater fish is not straightforward because of the variation in tissue levels associated with toxic effects of methylmercury. Also, the rate of accumulation and exposure time seem to significantly affect its toxicity to fish (Wiener and Spry, 1996). Niimi and Kissoon (1994, cited in Beckvar et al., 1996) suggest that a total mercury body burden of 1-5 µg/g wet weight represents a threshold concentration for chronic adverse effects in aquatic organisms, including rainbow trout.

McKim et al. (1976) exposed three generations of brook trout to methylmercury in their water. Exposure of consecutive generations of animals in a laboratory toxicity test is uncommon, despite special relevance to exposures of natural populations. Significant mortality of first generation fish occurred after 16-28 weeks exposure to 2,930 ng/l (ppt) methylmercury. Mean muscle residues of 23.5 µg/g mercury occurred in dead fish in this exposure group. Mortality of second generation fish occurred after 64-100 weeks of exposure to 900 ng/l, with mean muscle residues of 9.5 µg/g mercury. There were signs of impaired reproduction in first generation fish and complete reproductive failure in second generation fish exposed to 900 ng/l methylmercury. Exposure to 290 ng/l methylmercury to three generations over the 144-week period resulted in no significant toxicity. Muscle of adult fish contained 4.9 µg/g mercury prior to spawning in this exposure group. As expected from results of 290 ng/l exposures, fish exposed to 90 ng/l methylmercury accumulated 1.9 µg/g muscle mercury concentrations without any signs of toxicity (McKim et al. 1976). This muscle concentration is the best available estimate for an upper range of mercury residues tolerated by a salmonid (Curtis 1997).

However, these thresholds should be used with caution because lower concentrations may still affect behavior and reproduction, although not as dramatically or quickly as the higher concentrations. Few data are available on these subtle effects of mercury because, until recently, laboratory studies used exposure concentrations that were much higher than concentrations in the environment (Zillioux et al., 1993). Wiener and Spry (1996) state that "[i]n rainbow trout, whole-body concentrations of about 10 µg/g wet weight or greater seem to be associated with sublethal or lethal toxic effects (such as emaciation, lack of appetite or feeding, reduced growth, etc.). However, given the extreme neurotoxicity of methylmercury, behavioral studies might show that the behavior of adult fish is affected at tissue concentrations much lower than those indicated above. Many fish behaviors are sensitive and ecologically relevant indicators of contaminant toxicity that are affected at exposure concentrations much lower than those causing direct mortality. Laboratory bioassays have shown that survival of fish embryos can be substantially reduced by a seemingly minute quantity of either inorganic mercury or methylmercury within the fertilized egg, whether from waterborne exposure or maternal transfer." (Wiener and Spry 1996, p.321).

Based on Birge et al.'s (1977) work, Wiener and Spry (1996) state that "embryonic mortality probably coincided with inorganic mercury concentrations of about 0.07 to 0.10 µg/g wet weight in the fertilized eggs, concentrations that are less than 1% of the tissue residues associated with overt mercury toxicity in adult rainbow trout." Whole body mercury concentrations are not a good indicator of ovary mercury concentrations since the ovaries contain smaller concentrations than most other tissues and organs, and presumably whole body mercury concentrations. Niimi (1983) found that whole body mercury concentrations in gravid female rainbow trout were more than 20 times as high as mercury concentrations in their eggs. According to Beckvar et al. (1996), "[w]e begin to become concerned about reproductive or early life stage effects when total mercury in whole bodies of fish are between 0.5 and 1.0 mg/kg" (µg/g).

2. <u>Mercury effects of MTH project on resident fluvial UR cutthroat trout</u>. The MTH project is not expected to change the effects of mercury on resident fluvial UR cutthroat trout (see above definition of this population) because the project will have no effect on the habitat of this

population. While CH_2M Hill (1995) found elevated water and sediment mercury concentrations in an unnamed Lane Creek tributary (which would be a tributary of the proposed reservoir and thus probably provide habitat for resident fluvial UR cutthroat trout), this is not due to the proposed MTH dam, nor will mercury water and sediment concentrations in resident fluvial UR cutthroat trout habitat change as a result of the MTH project. Thus mercury effects on resident fluvial UR cutthroat trout will be no worse with the MTH project than without it.

3. Mercury effects of MTH project on resident lacustrine UR cutthroat trout. For the purposes of this biological opinion, resident lacustrine UR cutthroat trout are defined as UR cutthroat trout that will use the proposed MTH reservoir for any part of their life cycle. Since the MTH project does not include fish passage, these fish will be permanently trapped above the dam. UR cutthroat trout currently existing in the MTH project area would be expected to adapt to the new reservoir environment and exhibit life history characteristics of other lacustrine coastal cutthroat trout populations. The most likely adaptations would be greater longevity and piscivorousness than the current resident fluvial UR cutthroat trout. Pierce (1984, cited in Trotter 1989) reported that lacustrine cutthroat usually spawned for the first time at age 4, while June (1981, cited in Trotter 1989) found that resident coastal cutthroat trout in headwater streams (such as the ones in the MTH area) rarely even survived to age 4. Pierce (1984, cited in Trotter 1989) found that coastal cutthroat trout in Crescent Lake on the Olympic Peninsula in Washington became intensely piscivorous after reaching about 30 cm in length. Greater longevity and piscivorousness, along with more abundant food resources, would lead to greater size in the resident lacustrine UR cutthroat trout population than in the current resident fluvial population. Feeding habits, size, and age of fish influence mercury uptake, with larger, older, more piscivorous fish tending to accumulate more mercury (Beckvar et al. 1996). The adaptations of the resident lacustrine UR cutthroat trout to the MTH reservoir environment would likely increase bioaccumulation of mercury in these fish.

An example of higher concentrations of mercury in older lacustrine cutthroat is provided by Worcester (1979). He collected samples of 1+ and 2+ cutthroat trout from Cottage Grove Reservoir (CGR) on the same day, which showed significantly higher lateral muscle mercury concentrations in the older fish (mean of 0.39 µg/g ± 0.11 [standard deviation] for eight 1+ fish vs. mean of 1.02 µg/g ± 0.48 for two 2+ fish). Mercury accumulation is closely correlated with a piscivorous diet as well as age. E.g., MacCrimmon et al. (1983) found that the rate of mercury accumulation in lake trout increased greatly when the fish became large enough to change from a diet of invertebrates to forage fish. Also, Stafford and Haines (1997) found that mercury concentration increases with fish age or size and can reach high concentrations even in relatively small fish that are long lived.

Based on the likely life history adaptations of resident lacustrine UR cutthroat trout (see above paragraphs), and the analyses presented in "Post-project waterborne mercury at MTH site", "Post-project sediment mercury at MTH site", and Post-project fish tissue mercury at MTH site above, NMFS concludes that (1) the waterborne mercury within the MTH reservoir will be higher than the average waterborne mercury CH_2M Hill (1995) found in the streams within the MTH project area (low flow average of 1.77 ng/l and high flow average of 7.03 ng/l), and (2) the sediment mercury within the MTH reservoir will be higher than the average sediment mercury CH_2M Hill (1995) found in stream sediments within the inundation area (average of 0.240µg/g within the inundation area). Therefore, mercury concentrations in resident lacustrine UR cutthroat trout residing in MTH Reservoir are likely to be higher than current mercury concentrations in resident UR cutthroat trout in the MTH area.

CH_2M Hill (1995) attempted to model mercury cycling in MTH reservoir and extrapolate expected mercury concentrations in piscivorous fishes inhabiting the reservoir, but inadequate data and inappropriate assumptions resulted in questionable results (see "Mercury Cycling Model" in Attachment 3). NMFS does not know of a model that could be used to more accurately predict the expected mercury concentrations in piscivorous fishes inhabiting the reservoir, thus the only means of predicting these concentrations is from a comparable reference site such as CGR. In the "**d. Comparison with Cottage Grove Reservoir Watershed**" analysis above, the similarities and differences of the CGR watershed and the MTH site are described as well as the rationale for concluding that the risk of mercury bioaccumulation is less at the MTH site than at CGR. The only mercury concentration data for CGR adult cutthroat trout are found in Worcester (1979), who tested two 2+ cutthroat and found lateral muscle mercury concentrations of 0.58 µg/g (fork length=29.5 cm) and 1.36 µg/g (fork length=38.0 cm) (wet weight), for an average of 1.02 µg/g. As the risk of mercury bioaccumulation appears to be less at the MTH site than at CGR, the mercury concentrations in 2+ cutthroat trout inhabiting the MTH Reservoir are expected to be less than that found by Worcester (1979) in cutthroat from CGR.

Since individuals continue to bioaccumulate mercury throughout their lives, especially the more piscivorous they become, lateral muscle mercury concentrations in 3+ and older cutthroat trout (lacustrine cutthroat often live over 5 years) would be higher than Worcester (1979) found for the 2+ fish. These 2+ fish were at the beginning of their piscivorous life history stage, and reflect minimum mercury concentrations for reproductively active cutthroat trout. Considering Worcester's data, the life history of lacustrine cutthroat, and the current waterborne and sediment mercury concentrations at the MTH site, mercury concentrations in age 3+ and older resident lacustrine UR cutthroat trout lateral muscle in MTH reservoir may be equal to or greater than the concentrations found by Worcester (1979) in 2+ CGR cutthroat trout (whole body concentrations would be lower than lateral muscle concentrations).

As described above, McKim et al.'s (1976) brook trout work provides the best available estimate for an upper range of mercury residues tolerated by a salmonid. He found that exposure to 290 ng/l waterborne methylmercury to three generations of brook trout over the

144-week period resulted in no significant toxicity. Muscle of adult fish contained 4.9 µg/g mercury (whole body samples contained 3.4 µg/g mercury) prior to spawning in this exposure group. This exposure concentration (290 ng/l) is a higher concentration of waterborne mercury than was found in any of the samples collected from streams at the MTH site by CH_2M Hill (1995), including the small tributary draining the Elkhead Mine and Thompson Prospect areas (262.8 ng/l). The waterborne mercury concentrations in the samples collected from streams at the MTH site by CH_2M Hill (low flow average of 1.77 ng/l and high flow average of 7.03 ng/l) were 1-2% of the 290 ng/l exposure concentration used by Mckim et al. (1976).

NMFS considers it unlikely that mercury concentrations in lacustrine cutthroat inhabiting MTH Reservoir will be high enough to cause direct mortality. However, based on the information in "1) Mercury effects on cutthroat trout: **Fish tissue**" above (e.g., Beckvar et al.'s (1996) reproductive and early life stage concern threshold of 0.5 to 1.0 µg/g mercury in whole body samples), the behavior and reproduction of resident lacustrine UR cutthroat trout are likely to be seriously affected by mercury at the MTH site unless mercury runoff into the reservoir is minimized. These effects will be compounded for resident lacustrine UR cutthroat trout spawning or rearing in MTH reservoir tributaries with elevated water or sediment mercury concentrations (see "1. Mercury effects on cutthroat trout: **Water**" & "**Sediment**" above).

4. Mercury effects of MTH project on potentially anadromous UR cutthroat trout. CH_2M Hill (1995) did not find that significant amounts of mercury had been transported downstream from the Elkhead Mine area to Elk Creek. However, as explained above ("Post-project waterborne mercury at MTH site" and "Post-project sediment mercury at MTH site"), mercury concentrations are likely to be higher in MTH reservoir water and sediments than current concentrations in Elk Creek water and sediments in the inundation area unless mercury runoff into the reservoir is minimized. Seim and Park (1996) and Park and Curtis (1997) found that sediment in the Coast Fork of the Willamette River downstream of Cottage Grove Dam had mercury concentrations more than twice as high as sediments in the river at its confluence with the reservoir (1.75 µg/g vs. 0.83 µg/g). The mercury point-source for Cottage Grove Reservoir is approximately 15 miles upstream of the reservoir. Thus, mercury-laden sediment accumulates in the reservoir and apparently is flushed downstream by drawdowns.

The high concentration of mercury in sediments below Cottage Grove Dam may be due to the small particle size of mercury-containing solids at the Black Butte Mine, since they would be readily resuspended by turbulent flow through the dam (L. Curtis, E. Tennessee U., pers. comm.). At the Lahontan Reservoir in Nevada, where mercury point sources are located above the dam, Bonzongo et al. (1996) found that sediment mercury immediately below the dam was much less than sediment mercury in the reservoir substrate. At this reservoir, Miller et al. (1995) found that sediment mercury was highest in the deepest part of the reservoir. Based on these and Bonzongo et al.'s findings, Lahontan Reservoir seems to act as a sediment trap for mercury (but mercury also appears to be making its way into fish tissue downstream of the dam - see below).

For fish occurring downstream of the MTH dam, fish tissue mercury could increase due to increased mercury concentrations in water and sediments (inorganic mercury and methylmercury) in Elk Creek due to downstream transport from the reservoir. Even at sites where mercury sources occur upstream of a dam, elevated sediment and fish tissue mercury concentrations have been found downstream of the dam (e.g., sediments at CGR). A fish tissue example is provided at Lahontan Reservoir, Nevada, which is below the mercury point-source in the Carson River watershed (Bonzongo et al., 1996), where Ekechukwu (1976, cited in Cooper 1983) found higher mercury levels in common carp in the river downstream of the river than Cooper (1983) found in the same species within the reservoir. Likewise, Verdon et al. (1991) found that fish tissue mercury increased several fold in the La Grande Hydroelectric Complex area in Quebec, Canada, after construction of the project, with the highest increases being found in fish below the project. The common perception that reservoirs act as contaminants sinks does not appear to hold true for mercury at these projects, nor should it be assumed that this will be the case at MTH Dam.

Based on the literature cited above, the current mercury concentrations in water and sediment at the MTH site, and the proposed operation of the MTH Reservoir, NMFS concludes that mercury will be transported downstream of the dam and taken up by fish. The proposed operation of the MTH Dam will probably increase the likelihood of mercury uptake in Elk Creek anadromous salmonids unless mercury runoff into the reservoir is minimized. The project will drastically increase summer and fall flows, especially in the reach immediately below the dam where mercury concentrations would be the highest, and where anadromous fish will be drawn. Birge et al. (1977) reported that rainbow trout eggs incubated and hatched in sediment with 1.050 mg Hg/kg (µg/g) resulted in 42% mortality at hatching and 55% mortality 10 days after hatching (a control group of eggs incubated in sediment with 0.052 mg/kg had 5% mortality at hatching and 6% mortality ten days after hatching).

5. Summary of MTH project's mercury effects on UR cutthroat trout. The MTH project is not expected to worsen mercury effects on resident fluvial UR cutthroat trout (these fish may be adversely affected by mercury, but this will not be due to the MTH project). The project, as proposed, is expected to worsen mercury effects on resident lacustrine UR cutthroat trout, which may impair behavior and reproduction, particularly over the short-term (first few years after project is completed). The project, as proposed, is expected to worsen mercury effects on potentially anadromous UR cutthroat trout, particularly over the long-term as mercury-laden sediment is transported downstream of the dam.

6. Mitigation. The Milltown Hill Project Mitigation, Enhancement and Monitoring Plan (mitigation plan; Appendix 2 in USDI 1996a) describes five proposed fisheries mitigation measures: (1) stream

flow, (2) gravel placement, (3) structures in Elk Creek, (4) structures within the reservoir, and (5) supplementation. Restoring aquatic habitat to mitigate for the loss of anadromous salmonid habitat caused by the dam is the primary objective of the Milltown Hill mitigation plan. Besides flow and water quality alterations (also addressed above in "3. Alterations in Flow and Water Quality"), gravel and structure placement in Elk Creek below the dam are the two proposed mitigation measures in the original BA that are intended to restore anadromous salmonid habitat. These measures are addressed below. Structures within the reservoir may affect UR cutthroat trout and are also addressed in this section. Supplementation was not proposed by USDI (1996a) other than a commitment to consult with NMFS in planning such mitigation, thus it is not covered by this biological opinion. In its comments on the draft MTH project biological opinion and amendment to the MTH project BA, USDI (1997b) proposed habitat restoration as an additional mitigation measure, and this is discussed in **"e. Effects of Habitat Restoration Mitigation."** below.

a. Criteria for Evaluation. Mitigation includes (1) avoiding an impact by not taking a proposed action, (2) minimizing an impact by changing the design of a proposed action, (3) rectifying an impact by repairing, rehabilitation, or restoring the affected environment, (4) reducing or eliminating an impact over time by preservation/maintenance operations, and/or (5) compensating for an impact by replacing or by providing substitute resources (40 FR § 1508.20). Natural resource agencies generally recommend mitigation options in the priority listed above (USDE 1991). NMFS considers mitigation that does not avoid, minimize, or fully compensate for impacts to be inadequate.

NMFS evaluated the proposed mitigation for the MTH project using the following criteria:

a. Mitigation should compensate for habitat loss due to the project by securing, for at least the duration of the project, an equal or greater amount of habitat with an equal or greater potential for anadromous salmonid production. The mitigation habitat should be at least as contiguous as the lost habitat (i.e., mitigation habitat can not be more fragmented than the lost habitat).
b. Mitigation should mimic, or minimize disruption of, natural ecological processes.
c. The project proponent (e.g., agency and/or company/individual funding, permitting, or building it) should have the ability to fund and carry out all mitigation measures. All mitigation measures should be implemented and completed before construction of the project is started, or an enforcement mechanism should be applied to ensure implementation and completion of all mitigation measures concurrent with the project or within a specific timeframe.

b. Effects of Stream Flow Mitigation. The proposed flow augmentation of Elk Creek from the MTH project during the summer and early fall would ameliorate some of the primary limiting factors for anadromous salmonids, likely resulting in increased rearing habitat and potential production of these species, including UR cutthroat trout. The effects of stream flow alteration due to the project (including summer augmentation) is discussed in "**V.A. Effects of the Action**, 3. Alterations in Flow and Water Quality" above.

c. Effects of Instream Structure Mitigation. Habitat mitigation proposed for the project should be as permanent as the dam itself, and long-term effectiveness and durability should be the primary criteria for any mitigation program (criteria "a" above). In Elk Creek, instream placements will used primarily in the 3 miles of stream between the damsite and the mouth of Adams Creek, and riparian improvements will be done primarily in between Adams Creek and Drain. Instream placements will follow the design guidelines presented in the "Umpqua Fish Management District's Guide to Instream & Riparian Restoration Sites and Site Selection" by Nicholas et al. (1996), and in "A guide to Placing Large Wood in Streams" (ODF and ODFW 1995).

Poor stream conditions are typically the result of riparian and watershed degradation in conjunction with instream problems (Nehlsen et al. 1991, Reeves and Sedell 1992, Frissell et al. 1993; Beschta 1997). Therefore the importance of approaching habitat restoration efforts from an ecosystem perspective cannot be overemphasized. In Elk Creek, anadromous salmonid habitat has been degraded due to the cumulative effects of numerous watershed-scale land use activities, such as agricultural practices, road-building, and timber harvest (USDI 1996b). As in most disturbed watersheds, a large percentage of human activity in the Elk Creek subbasin is concentrated in the riparian areas. Adequate riparian vegetation is essential for salmonid habitat in small streams such as Elk Creek and functions to provide much more than just shading, including (1) streambank stability (e.g., roots), (2) formation of overhanging and undercut banks, (3) supply of large woody debris to streams, (4) input of organic matter (e.g., leaves), (5) accumulation of sediment during peak flows, upon which more plants grow, and 6) filtration of sediments from uplands (FEMAT 1993, Beschta 1997).

When properly designed, instream structures or placements can be an effective, although relatively short-term, component of a mitigation or restoration program. Such projects are successful on certain streams and ineffective or even detrimental on others (Frissell and Nawa 1992, Crispin et al., 1993, Kondolf et al. 1996). Uncertain results occur for a variety of reasons including (1) a poor understanding of river response to such structures, (2) lack of both field experience and/or documented procedural guidelines, (3) economic and time constraints which limit the amount of consultation and pre-project research, (4) lack of state-of-the-art knowledge as to the suitability of the structures under various field conditions, and (5) tendency to install the same familiar structure on all stream types (one size fits all). These limitations can be overcome by integrating related disciplines such as hydrology and geomorphology into project planning, providing a basis for the critical first step in which the project site and type are selected (Rosgen 1996).

A basic understanding of stream channel dynamics will assist instream project planning and minimize failure rates by selecting appropriate improvement designs for various streams. Channel patterns are self-developed and self-maintained such that any change in the variables responsible for such patterns sets up mutual adjustments within the channel. Changes in velocity, depth, width, channel materials, discharge, sediment supply, and slope initiates a series of concurrent adjustments between these variables in order to seek a quasi-equilibrium. Results of such adjustment often cause aggradation, degradation, lateral channel migration, accelerated bank erosion, increased sedimentation, and/or substrate material size shifts. These consequences of channel adjustments can often result in actual decreases in habitat quality, even though the initial adjustments were caused by instream structures designed to improve the habitat. These unintended effects can be avoided or minimized by selecting project designs appropriate for the morphological stream channel type (Rosgen 1996). The proposed instream structure mitigation will follow Rosgen's instream structure guidance both in location and design (USDI 1997b), and thus is likely to mimic, or at worst minimize disturbance of, aquatic ecosystem processes in Elk Creek.

d. Effects of Structures in the Reservoir. The Milltown Hill Project Mitigation, Enhancement and Monitoring Plan (mitigation plan; Appendix 2 in USDI 1996a) states that the following structures will be left or placed in the reservoir: (1) most or all trees in the Walker Creek arm will be left standing (many of which are old growth); (2) some trees will be left standing in the area south of the causeway, which is to be a wetland/wildlife area; and (3) 10-15% of the main pool area, i.e., the reservoir outside of the Walker Creek arm and the wetland/wildlife area south of the causeway) will be covered by root wads, logs, or leave stumps. The UR cutthroat trout population inhabiting the reservoir is expected to benefit from this mitigation due to increased cover and nutrients.

e. Effects of Habitat Restoration Mitigation. Comments on NMFS's April 2, 1997, draft opinion and amendment to the original BA were received by NMFS from BOR on June 16, 1997 (USDI 1997b). This BA amendment included proposed habitat restoration as mitigation for the habitat loss due to the MTH project (i.e., habitat that would be blocked or inundated by the project), as outlined below (from USDI 1997b):

> "Douglas County will secure riparian habitat within four years on 12 to 16 miles of headwater streams accessible to anadromous cutthroat trout in not more than ten separate areas of the Umpqua Basin. "Secure" means to provide assurance that shading from a riparian canopy will have full opportunity to develop and that sedimentation from stream-side disturbance will be limited to background levels. This security will be provided on both sides of the stream for at least 70% of the stream mileage. Riparian protective measures could consist of any method(s) that NMFS, ODFW and Douglas County agree would be effective for the duration of the MTH project. Examples of measures that will secure such riparian habitat include conservation easements, purchase and set aside of riparian corridors, livestock exclosure from the stream, planting of stream-side brush and trees, and provision 1-5 cfs flow through the summer in headwater streams within the pipeline service area.
>
> The County will accomplish the following to secure 12-16 miles of "headwater" cutthroat trout habitat (USDI 1997b):
>
> a. Discharge up to 5 cfs of water into Yoncalla Creek near the southern city limits of Yoncalla, Oregon.
>
> b. Discharge between 1 and 2 cfs of water into Halo Creek, tributary of Yoncalla Creek as high in the watershed as the pipeline location will allow.

Note: Both discharges points will be designed to "aerate" the water from the pipeline so the water will be acceptable (DO and temperature) for fishery resources at point of discharge .

c. The riparian area adjacent to locations of stream flow augmentation of Yoncalla and Halo Creek will be secured, as described above.

Other options to meet the 16 minimum miles of habitat enhancement/protection:

d. Additional discharge points from the pipeline may be added if ODFW personnel believe benefits may be obtained from riparian protection and flow augmentation within the headwater streams adjacent to the pipeline.

e. The headwater protection will either occur within the Elk Creek basin or within the range on the white tailed deer.

In these areas, the riparian areas will be secured as described above.

In order to provide certainty that project actions for the benefit of fish and wildlife will be fully implemented, the measures described here and in the Biological Assessment (USDI 1996a) and its supplement (USDI 1997a) will be incorporated as requirements into the loan agreement with BOR" (USDI 1997b, p.27-29, 33).

The proposed habitat restoration mitigation was evaluated in terms of the criteria described in "6.a. Criteria for Evaluation of Mitigation." above. The first criterion is that habitat loss should be mitigated "by securing, for at least the duration of the project, an equal or greater amount of habitat with an equal or greater potential for anadromous salmonid production." Although the anadromous salmonid habitat above the MTH damsite is currently degraded, NMFS believes that it has a high potential for recovery because of two recent major aquatic habitat restoration efforts that are being implemented in western Oregon, including in the Elk Creek subbasin: the Oregon Coastal Salmon Restoration Initiative (OCSRI, on non-federal land) and the Northwest Forest Plan (NWFP, on federal land). These two efforts and their potential effect on anadromous salmonid habitat above the MTH damsite are described at the end of "1. Migration Barrier and Habitat Loss" above. Because the condition of the anadromous salmonid habitat above the MTH damsite is likely to substantially improve within the timeframe of this project (> 100 years) in the absence of the project, NMFS considers this habitat to have high potential for anadromous salmonid production. Compensation for the loss of 12-16 miles of such habitat with a patchwork of up to ten mitigation areas spread across the Umpqua Basin (together totaling 12-16 miles), within each of which up to 30% of the riparian areas may not be protected, does not meet the first mitigation criterion. Such fragmented and incompletely secured mitigation areas, whether flow augmentation occurs or not, are not likely to have as high a potential for fish production as 12-16 miles of contiguous anadromous salmonid habitat with a high potential for recovery, thus the first mitigation criterion is not met by the proposed habitat restoration mitigation.

The second criterion for evaluating mitigation is that it should mimic, or minimize disruption of, natural ecological processes. The proposed flow augmentation does not necessarily mimic natural ecological processes since flows in these streams would be naturally low and somewhat warm during the summer even under pristine conditions, but neither would it significantly disrupt natural ecological processes. The protection of riparian areas on any scale is consistent with natural ecological processes because it is a passive form of restoration that allows these processes to take place relatively undisturbed. Thus the second criterion is met by the proposed habitat restoration mitigation.

The third criterion for evaluating mitigation is assurance or certainty that the proposed measures will be implemented. The proposed habitat restoration mitigation is contingent on (1) Douglas County implementing it as agreed upon, and (2) agreement of private landowners. However, there is no recourse in the event of the failure of one or both of these steps taking place, thus this criterion is not met.

f. Conclusion. The effects of the proposed mitigation for the MTH project are summarized below in terms of their compliance with the evaluation criteria in "6. Mitigation, **a. Criteria for Evaluation**." above. For a given project such as MTH, at least one mitigation measure should satisfy Criterion "a" (appropriate compensation for habitat loss), and all mitigation measures should satisfy both Criteria "b" and "c". NMFS concludes that none of the four proposed mitigation measures (streamflow augmentation, instream structures, reservoir structures, or habitat restoration) satisfy the criterion to appropriately compensate for habitat loss due to the project. The only proposed mitigation measure designed to satisfy this criterion is that proposed to compensate for habitat loss in USDI 1997b, which is evaluated above in "6. Mitigation, **e. Effects of Habitat Restoration Mitigation**".

All four of the proposed mitigation measures satisfy the second mitigation evaluation criterion of mimicking, or minimizing disruption of, natural ecological processes. While some of the proposed mitigation measures do not necessarily mimic natural ecological processes (e.g., flow augmentation in the summer since flows in these streams would be naturally low and somewhat warm during the summer even under pristine conditions), neither do they significantly disrupt natural ecological processes. Other mitigation measures, such as the protection of riparian areas, are consistent with natural ecological processes because they are passive forms of restoration that allow these processes to take place relatively undisturbed. All the proposed mitigation measures, except the habitat restoration proposed as mitigation for habitat loss from the MTH project, satisfy the third mitigation evaluation criterion of having assurance of implementation.

Table 4. Compliance of MTH project's proposed mitigation measures with NMFS's evaluation criteria.

Proposed MTH project mitigation measures	NMFS's Evaluation Criteria (see "6. Mitigation, **a. Criteria for Evaluation**" above for full definitions of each criterion)		
	a. Appropriate compensation for habitat loss?	b. Mimics/minimizes disturbance, natural ecosystem processes?	c. Assurance of implementation?
Streamflow	no	yes	yes
Instream Structure	no	yes	yes
Reservoir Structure	no	yes	yes
Habitat Restoration	no	yes	no

When considered independently from the construction and operation of the MTH project, the effects of the proposed mitigation measures (streamflow augmentation, instream structures, reservoir structures, or habitat restoration) would be beneficial to anadromous salmonids. However, the purpose of mitigation is to avoid, minimize, or fully compensate for project impacts. NMFS believes that this can be accomplished if at least one mitigation measure satisfies Criterion "a", and all mitigation measures satisfy both Criteria "b" and "c" above. Our evaluation of the proposed mitigation measure shows that they do not meet this standard, and specifically that the habitat loss from the proposed MTH project would not be adequately mitigated by the proposed measures.

7. Monitoring and Evaluation. The effects of projects such as the proposed MTH Dam on aquatic habitat and species need to be thoroughly documented and objectively evaluated so that we can learn from and improve project performance, as well as applying lessons learned to other efforts (Kondolf 1995).

a. Monitoring and Evaluation at the Galesville Project. The fishery benefits predicted in the MTH BA (USDI 1996a) are nearly identical to those predicted for the Galesville Dam project, completed by Douglas County on Cow Creek in 1985 (Craven 1992). Craven (1992) demonstrated that Galesville Dam resulted in higher flows and lower temperatures in Cow Creek. Craven (1992), Douglas County staff, and Oregon Department of Fish and Wildlife (ODFW) biologists believe that Galesville Dam has had a positive effect on the anadromous salmonids of Cow Creek, although a number of confounding factors have prevented this from being validated.

The response of anadromous salmonids to the Galesville Dam project cannot be determined with a high degree of certainty due to the following factors: (1) the stocking by ODFW of unmarked hatchery fish in the Cow Creek Basin and throughout the South Umpqua, so hatchery and natural adults cannot be distinguished; (2) the data from the Cow Creek screw trap operated by Douglas County is difficult to interpret because of highly variable trap efficiency estimates; (3) there was no systematic sampling of fish in Cow Creek before the dam was completed; and (4) there has been no systematic sampling of adult anadromous salmonids that the project should have benefited (coho and steelhead)(S. Cramer, pers. comm.). In short, an opportunity to determine how anadromous salmonids respond to stream regulation has been lost due to nonexistent pre-project, and ineffective post-project, monitoring and evaluation.

While monitoring the response of anadromous salmonid populations to Galesville Dam may be difficult, monitoring of instream habitat and riparian response should be relatively straightforward. However, Douglas County has not conducted any fish habitat surveys (either pre- or post-project) to evaluate fish habitat response to the highly altered stream reach below Galesville Dam. Craven's (1992) analysis of the Galesville project's effect on anadromous salmonids and the stream below the project contained one paragraph stating that the increased summer flows and lower water temperatures have greatly increased spawning and rearing habitat. No data or sources were given to support these statements (p.24), but a physical habitat inventory was recommended. As for riparian vegetation response to the Galesville project, Craven (1992) noted that some post-project riparian vegetation monitoring methods were being developed. Again, an opportunity to determine how instream habitat and riparian vegetation respond to stream regulation has been lost due to poor monitoring and evaluation.

b. Proposed Monitoring and Evaluation at the MTH Project. The effects of projects such as the proposed MTH Dam on aquatic habitat and species need to be thoroughly documented and objectively evaluated so that we can learn from and improve project performance. Douglas County has gained considerable experience at the Galesville project and is proposing monitoring and evaluation at the MTH project that is likely to be much more effective than at Galesville. NMFS believes that while biotic measures such as escapement and redd counts are useful components of any evaluation program, monitoring of changes in physical habitat and aquatic ecosystem health (e.g., macroinvertebrates) should be emphasized since fish abundance can be influenced by factors unrelated to the project (Kondolf and Micheli 1995). Thus monitoring and evaluation should be designed to determine at least the following pre- and post-project conditions in all stream reaches (Elk Creek and tributaries) affected by the project downstream of the damsite: (1) flow, temperature, and other water quality parameters, (2) instream and riparian habitat conditions, (3) adult and juvenile UR cutthroat trout, coho, and steelhead abundance, (4) abundance and species richness of aquatic macroinvertebrates. The proposed monitoring and evaluation on the MTH project for each of these conditions is described and evaluated below (from "Mitigation, Enhancement and Monitoring Plan", Appendix 2 of USDI 1996a, and USDI 1997a).

1. <u>Proposed monitoring of flow, temperature, and other water quality parameters</u>. Monitoring will be designed to track reservoir inflows, reservoir storage, reservoir outflows, and downstream flows. Each of these volumes must be known to regulate water allocation to its various uses, and to regulate the rate of water usage for optimum annual benefits. At least hourly

measurements will be maintained for reservoir surface elevation, outflow, and flows at three locations downstream. Douglas County will maintain three continuous recording gaging stations on Elk Creek and have a staff gage (rated) installed in Yoncalla Creek within ¼ mile of the pipeline discharge into Yoncalla Creek.

Temperature will be monitored at key inflow points, at various depths in the reservoir, and at key locations downstream. Temperature data will be used to evaluate its relationship to fish growth and distribution, and to determine downstream extent of favorable fish-rearing temperatures during summer. Continuous thermographs with telemetry for remote monitoring will be placed near the dam at two elevations within the reservoir, at RM 37.5, at RM 26 near Drain, and at RM 2.5. Additional continuous temperature loggers will be deployed and retrieved monthly at an additional five locations.

The potential for low dissolved oxygen, low pH, and high turbidity are concerns in the discharge water at the dam. Turbidity will be of greatest concern in the winter and spring, while low dissolved oxygen and pH will be a concern only when water withdrawals dip into the hypolimnion late in the summer or early fall. Because these parameters will be measured manually, and all measurements will be made in the tailrace of the dam, all three parameters will be measured when there is need to measure any one of them. The standard frequency of sampling in the first year of operation will be once every two weeks. Water quality at various depths within the body of the reservoir will be tested each year in April and in September. Water samples will be tested for dissolved oxygen, pH, and turbidity. All water quality monitoring involving trace metals and mercury issues will be accomplished in accordance with the Oregon DEQ 401 water quality certification. These tests include fish tissue samples, soil sampling and water samples. Specifics on amount and type of samples are not included as a part of the fish and wildlife program (USDI 1997a).

2. <u>Proposed monitoring of instream and riparian habitat conditions</u>. The area and composition of both natural and artificial gravel patches in the stream will be determined by a single survey each year, probably in late October after streams have risen, but before fall chinook and coho spawning peaks. The first survey will be completed in the year before construction of the dam is complete, and will establish baseline conditions. The area and gravel size composition of each artificial gravel placement will be measured. The area and composition of natural spawning gravels will be surveyed in five index reaches of stream, each approximately 1 mile long, and disbursed evenly over the 39 miles of Elk Creek below the dam.

   The quantity of habitat types and natural instream structure is also likely to be influenced by the flow stabilization from Milltown Hill Dam, so these characteristics will be measured during the same surveys specified for spawning gravel. Standard stream survey procedures now used by the ODFW Research Section will be followed. The first survey will be completed in the year before construction of the dam is complete, and will establish baseline conditions. All artificially placed structures will also be surveyed each year. Artificial structures will only be replaced if natural recruitment of instream structure is slower than the attrition of artificial structures.

Research by ODFW on the habitats used during winter by juvenile salmonids indicates that such habitats are in short supply, and can only be surveyed during winter when they water up at high winter flows (Nickelson et al. 1992). Therefore, the location and quantity of preferred winter habitat for juvenile salmonids will be surveyed over the entire stream length below the dam during the first winter of normal reservoir operation. Reductions in winter flow as water is stored in the reservoir may influence winter habitat availability, so the water levels at which such habitats are watered and de-watered will be noted on the surveys. Opportunities for construction of improvements to winter habitat will also be noted on this survey (USDI 1997a).

3. <u>Proposed monitoring of adult and juvenile UR cutthroat trout, coho, and steelhead abundance</u>. Hatchery supplementation of UR cutthroat trout, coho, or steelhead by ODFW is planned to be very limited in Elk Creek. ODFW has no current plans for smolt releases, but presently approves fry stocking projects for coho based on annual adult spawner escapement levels and available stream habitat capacity. Hatchery fish released as smolts will be marked and hatchery fish released as fry or presmolts might be unmarked. Plans will be developed between ODFW, NMFS and the County to insure that monitoring of the project is not compromised. These plans may include limiting releases of hatchery fish to specific tributary streams, using scale analysis to distinguish hatchery and wild fish, or use of a mark on all or a portion of the hatchery fish.

   The density and distribution of UR cutthroat trout, coho, and steelhead adults will be monitored by counting redds and spawners both above and below the reservoir to determine how adults are responding to project features, and to identify areas of opportunity for increasing project benefits to fish. Surveys will be completed principally on foot for these three species. Surveys will commence immediately upon approval of the project, such that one to two seasons of sampling are completed to establish baseline conditions before the project begins operating.

   The density and distribution of UR cutthroat trout, coho, and steelhead juveniles below the dam will be monitored by rotary screw traps and snorkel counts. UR cutthroat trout will be sampled in the reservoir by trap netting. Sampling will commence immediately upon approval of the project, such that one to two seasons of sampling are completed to establish baseline conditions before the project begins operating. Snorkel surveys will be completed once each year in mid summer, usually August (USDI 1997a).

4. <u>Monitoring of aquatic macroinvertebrate abundance and species richness</u>. No macroinvertebrate sampling is proposed due to (1) the improbability of relating changes in macroinvertebrate abundance or species richness to growth or survival of UR cutthroat trout,

coho, or steelhead, and (2) the effort and cost required for keying out and counting the macroinvertebrate samples (USDI 1997a).

5. Evaluation of Proposed Monitoring. The proposed flow, water quality, stream habitat, and salmonid population monitoring is quite thorough and addresses the shortcomings of the Galesville monitoring program noted above. However, the timing, implementation, and reporting of the multiple tasks required for the MTH monitoring program should be more structured and better organized. While some flexibility in the monitoring tasks is needed, very little detail is given in the monitoring plan on what, where, when, and how monitoring will be carried out because ODFW has the responsibility of determining all of this. The less detail that is given on monitoring commitments, the more likely it is that monitoring tasks will slip in priority and not be carried out, especially when the duration of the project is considered (i.e., a century or more).

   Water quality monitoring in the reservoir and in the tailrace (and further downstream for temperature) is proposed, and there is an acknowledgment that hypolimnion releases in the summer and fall could lead to pH and other water quality problems. However, no contingencies are described for handling a situation in which one or more water quality parameters become problematic. Simply stating that ODFW will determine how to react to problems as they arise is inadequate. As noted above, NMFS believes that pre- and post-project stream and riparian habitat monitoring is critical for determining how the project is affecting aquatic resources. The proposed use of ODFW's Aquatic Habitat Inventory methodology for monitoring affected stream reaches is a good first step in accomplishing this. A low-cost monitoring method that could supplement this is the use of photo-points along these reaches (i.e., photographing the reaches from the same point at the same times each year). In addition, a good measure of stream ecosystem health is the abundance and species richness of aquatic macroinvertebrates.

8. Interrelated and Interdependent Effects. Effects of the action also include effects of actions that are interrelated or interdependent with the proposal under consideration. An interrelated or interdependent action is one that would not occur but for the proposed action. According to the project's EIS (USDI 1992), the MTH project would:

- provide irrigation water for up to 4,661 acres in the Elk Creek subbasin (full supply for up to 3,764 acres and a supplemental supply to 897 acres),
- provide water to Yoncalla, Drain, and Rice Hill for municipal expansion and industrial diversification,
- provide a reliable source of water for rural domestic use in the Elk Creek subbasin,
- provide opportunities to improve fish and wildlife habitat,
- improve water quality in Elk Creek and Yoncalla Creek,
- provide new water-related recreational facilities, and
- provide limited flood control in and near Drain.

The two major actions interrelated and interdependent to the MTH project (i.e., those that would not occur without the project) not addressed in sections 1-7 of "**V.A. Effects of Proposed Action**" above which would affect UR cutthroat habitat are expected to be (1) increased agricultural development, and (2) increased industrial development (including municipal expansion). Other interrelated and interdependent actions such as increased rural domestic water use and recreation are expected to have minimal effects on UR cutthroat habitat. A description of these interrrelated and interdependent actions is provided in Section 3.1 of the EIS (USDI 1992) ("Affected Environment and Environmental Consequences; Preferred Alternative"; p.3-1 to 3-108), which is hereby incorporated by reference.

The agricultural development resulting from the MTH project would consist primarily of providing irrigation water for up to 4,661 acres in the Elk Creek subbasin on what is currently mostly unirrigated pasturelands. According to the EIS (USDI 1992, p.3-90), there are currently 1,573 irrigated acres in the Elk Creek subbasin, thus the MTH project has the potential to increase the amount of irrigated acreage in this subbasin by four-fold. This large-scale conversion of untilled pasture to tilled, irrigated cropland would be a major land use change with significant implications for UR cutthroat habitat. Spence et al. (1996) state, "In general, the effects of agriculture on the land surface are more severe than logging or grazing because vegetation removal is permanent and disturbances to soil often occur several times per year. In addition, much agriculture takes place on the historical floodplains of river systems, where it has a direct impact on stream channels and riparian functions." See Spence et al. (1996, p.127-130) for descriptions of the different effects of agriculture on anadromous salmonid habitat.

In the Elk Creek subbasin, the agricultural development due to the MTH project may affect UR cutthroat habitat in a variety of ways at the subbasin scale. The replacement of pasture and other land with annual crops may result in large areas of tilled soil that will become increasingly compacted by machinery and only covered with vegetation part of the year. Riparian vegetation along intermittent and perennial streams used by UR cutthroat may be removed as irrigated acreage is maximized. The cropland irrigated by the MTH project will likely be tilled, fertilized, treated with pesticides, and harvested annually. This combination of activities is likely to cause degradation of riparian vegetation, reduction in infiltration, and increases in surface runoff and erosion, resulting in stream temperature increases, increased hydrologic disturbance, and sedimentation of streams in the Elk Creek subbasin. Water quality of these streams may be further degraded by nutrient enrichment (from fertilizers) and pesticide runoff.

As for irrigation return flows, approximately 19% of the water volume delivered by the MTH project is anticipated to re-enter Elk Creek and its tributaries as irrigation return waters, but the impacts of these return flows are not expected to be significant. This is due to the following three factors: (1) return flows are expected to be very low and would be conducted back to the channel throughout the year as ground water, (2) flow rates, methods of irrigation, soil types, and distances from the stream would make surface runoff negligible (e.g., a subsurface drainage system would be installed at the county's expense where irrigation water is not reabsorbed by the water table; USDI 1992, p.2-7), and (3) return flows that make it back to the stream would be diluted by increased flow releases from the dam in summer and by naturally high flows in winter (USDI 1992).

The EIS states that industrial development resulting from the MTH project would consist primarily of sand and gravel operations (USDI 1992; p.3-88). Sand and gravel removal from streams and floodplains can adversely affect anadromous salmonid habitat through a variety of physical and biological impacts (OWRRI 1995). The establishment of sand and gravel removal operations in the Elk Creek subbasin as a result of the MTH project is likely to result in additional degradation of stream structure, streambanks, and floodplains that provide for functional UR cutthroat trout habitat.

It is not possible to determine how much additional municipal expansion will occur with the MTH project compared to without the project (expansion that would occur anyway without the project is not an interrelated or interdependent action). Thus the interrelated and interdependent effect on UR cutthroat habitat of the municipal expansion that will be made possible by the water supply from the MTH project is difficult to predict. Due to the severe and long-lasting adverse effects of urbanization on anadromous salmonid habitat (in terms of effect to fish habitat, municipal development and urbanization are similar), this is considered an important interrelated and interdependent action to the MTH project. General urbanization effects on anadromous salmonid habitat are described in Spence et al. (1996, p.130-134). Increased urbanization in the Elk Creek subbasin as a result of the MTH project is likely to result in additional degradation of the hydrologic and erosional processes necessary to maintain and restore UR cutthroat trout habitat.

The effects of the agricultural, industrial, and municipal development that would not be possible without the MTH project will be realized at a larger scale (much of the lower-elevation portions of Elk Creek subbasin) than most of the direct effects of the construction and operation of the project (Elkhead Watershed and mainstem of Elk Creek). The interrelated and interdependent actions of the MTH project, as currently proposed, are likely to result in long-term degradation of UR cutthroat trout habitat as described above.

B. Critical Habitat. UR cutthroat trout critical habitat has been proposed (62 FR 40786; July 30, 1997), and it includes all stream reaches below natural impassable barriers in the Elk Creek subbasin as well as 300 foot riparian buffers along both sides of these streams. Because the proposed critical habitat is inclusive of the MTH project action area, and the above description of the effects of the proposed action includes habitat effects, a separate description of the effects of the project on proposed critical habitat here is not necessary.

C. Cumulative Effects. “Cumulative effects" are defined in 50 CFR 402.02 as those effects of "future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation.” The “action area” is defined as “all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." (50 CFR 402.02). Some components of the proposed MTH project, such as quarrying of rock for dam construction, road relocation and construction, municipal and irrigation water delivery, off-site mitigation, and other interrelated and interdependent actions will be done at various locations throughout the Elk Creek subbasin, hence this entire subbasin is considered as the action area (not to be confused with the Elkhead Watershed, where the MTH dam is to be located).

A substantial portion of spawning and rearing habitat in the Elk Creek subbasin for UR cutthroat trout is on U.S. Department of the Interior, Bureau of Land Management (BLM) land. Gradual improvements in habitat conditions for UR cutthroat trout are expected on these Federal lands as a result of Northwest Forest Plan implementation, as guided by ESA consultation. Historically, agriculture, livestock grazing, forestry and other activities on non-federal land in the Umpqua River Basin have contributed substantially to temperature and sediment problems in the Umpqua River Basin (USDI 1995a,b,c, 1996b; USDA 1995). This is particularly true of the Elk Creek subbasin due to a high percentage of non-federal land (about 80%), high road densities, and low elevation (no snowpack). Conditions on and activities within non-Federal riparian areas along stream reaches downstream of the BLM land presently exert a greater influence on river temperatures and probably contribute more sediment to the habitat of UR cutthroat trout in the Elk Creek subbasin than the BLM land.

Significant improvement in reproductive success of UR cutthroat trout outside of BLM land is unlikely without changes in agricultural, forestry, and other practices occurring within non-Federal riparian areas in the Elk Creek subbasin. NMFS is not aware of any future new (or changes to existing) State and private activities within the action area that would cause greater impacts to listed species than presently occurs. This does not include the effects of interrelated and interdependent actions described above. Now that UR cutthroat trout are listed as endangered, NMFS assumes that non-Federal land owners will take steps to curtail or avoid land management practices that would result in the take of this species. In addition, coho habitat on non-federal land that is affected by forestry and agricultural practices, such as that above the MTH damsite, should be better protected in the future due to the OCSRI.

For actions on non-Federal lands which the landowner or administering non-Federal agency believes are likely to result in adverse effects to Umpqua River cutthroat trout or their habitat, the landowner or agency should work with NMFS to obtain the appropriate ESA section 10 incidental take permit, which requires submission of a habitat conservation plan. If a take permit is requested, NMFS would likely seek project modifications to avoid or minimize adverse effects and taking of listed fish.

D. Summary. For this consultation, NMFS finds that the effects of the proposed action are best expressed in terms of the likely impact on environmental factors that define properly functioning freshwater aquatic habitat necessary for survival and recovery of UR cutthroat trout. Individual environmental factors include water quality, habitat access, physical habitat elements, channel condition, and hydrology. Properly functioning watersheds, where all of the individual factors operate together to provide healthy aquatic ecosystems, are also necessary for the survival and recovery of the UR cutthroat trout. This information is summarized in Attachment 1 and in NMFS's "Matrix of Pathways and Indicators" (NMFS 1996). Thus the effects of the construction and operation of MTH Dam on the environmental baseline of the action area (and thus the UR cutthroat trout) are summarized here using the methodology outlined in these documents. Effects of actions are expressed in terms of the expected effect (i.e., restore, maintain, or degrade proper functioning) on each of approximately 17 aquatic habitat factors in the action area (defined in "IV. Evaluating Proposed Actions/ B. Environmental Baseline: Action Area" above), as described in NMFS (1996) and shown in Table 5 below.

Table 5. Summary checklist of environmental baseline and effects of MTH project (including interrelated, interdependent, and cumulative effects) on relevant indicators in the action area (i.e., Elk Creek subbasin). Footnotes appear on the following page.

PATHWAYS:	ENVIRONMENTAL BASELINE[1] (From USDI 1996a, 1996b, 1997a; CH_2M Hill 1996; Craven 1989c,d; professional opinions & observations)			EFFECTS OF THE ACTION(S)[1,2] (Supporting documentation from this opinion is footnoted for each indicator)		
INDICATORS	Properly Functioning	At Risk	Not Propr. Functioning	Restore	Maintain	Degrade
Water Quality:						
Temperature			X	X MECBD[3]		X AOS[3]
Sediment			X			X[4]
Chem. Contamination			X			X[5]
Habitat Access:						
Physical Barriers	X				X MECBD[6]	X AOS[6]
Habitat Elements:						
Substrate			X		X MECBD[7]	X AOS[7]
Large Woody Debris		X		X MECBD[7]		"
Pool Frequency		X		"		"
Pool Quality		X		"		"
Off-channel Habitat		X		"		"
Refugia			X	"		"
Channel Condition:						
Width/Depth Ratio		X			X MECBD[7]	"
Streambank Cond.			X	X MECBD[7]		"
Floodplain Connectivity			X		X MECBD[8]	"
Flow/Hydrology:						
Peak/Base Flows		X		X base flows MECBD[8]		X peak flows MECBD, both AOS[8]
Drainage Network Increase			X			X[9]

Table 5 (continued from previous page).

<u>Watershed Conditions:</u> Road Dens. & Loc.	X	X[10]
Disturbance History	X	"
Riparian Areas	X	"

1 All environmental baseline indicators are for the action area as a whole (Elk Creek subbasin), and thus include Elk Creek tributaries as well as the mainstem. These three categories of function ("properly functioning", "at risk", and "not properly functioning") and the three effects ("restore", "maintain", and "degrade") are defined for each indicator in NMFS (1996).

2 "MECBD" (Mainstem Elk Creek Below Dam) refers to the mainstem of Elk Creek below the MTH damsite and the two tributaries that will be augmented with water (lower reaches of Yoncalla and Adams Creeks). "AOS" (All Other Streams) refers to all streams, including the mainstem of Elk Creek above the damsite, in the Elk Creek subbasin except for MECBD. Effects of the Action X's that do not indicate MECBD or AOS are for the entire Elk Creek subbasin.

<u>For footnotes #3-10, see cited "Effects of Proposed Action" section</u>:

3 See "Alterations in Water Quality" and "Interrelated and Interdependent Effects"

4 See "Change in Sediment Transport and Storage" and "Interrelated and Interdependent Effects"

5 See "Effects of Mercury Bioaccumulation on UR cutthroat trout"

6 See "Migration Barrier and Habitat Loss"

7 See "Migration Barrier and Habitat Loss", "Alterations in Flow and Water Quality", "Mitigation", and "Interrelated and Interdependent Effects"

8 See "Alterations in Flow and Water Quality: Effects on Stream Habitat"

9 See "Dam Construction" and "Interrelated and Interdependent Effects"

10 See "Interrelated and Interdependent Effects"

VI. Conclusion

As described in Attachment 2, the first steps in applying the ESA jeopardy and destruction/ adverse modification of critical habitat standards are to define the biological requirements of the ESU and to describe the listed species' status under the current environmental baseline. In the next steps, NMFS's jeopardy and destruction/adverse modification of critical habitat analysis considers how proposed actions are expected to directly and indirectly affect specific environmental factors that define properly functioning aquatic habitat essential for the survival and recovery of the species. This analysis is set within the dual context of the species' biological requirements and the existing conditions under the environmental baseline (defined in Attachment 1). The analysis takes into consideration an overall picture of the beneficial and detrimental activities taking place within the action area. If the proposed action (including interrelated/interdependent actions) and/or cumulative actions are found to jeopardize the continued existence of the listed species or result in destruction or adverse modification of critical habitat, then NMFS must identify a reasonable and prudent alternatives to the proposed action.

A. Standard Jeopardy and Destruction/Adverse Modification of Critical Habitat Analysis. For each consultation on proposed or ongoing actions affecting anadromous salmonids, NMFS applies ESA standards according to the framework set forth in Attachment 2 (p.2-4), and the biological requirements as described below and in NMFS (1996). The conceptual premise is that the survival and recovery of anadromous salmonids can be assured by providing for sufficient prespawning survival, egg-to-smolt survival, and upstream/downstream migration survival rates through the protection and restoration of properly functioning freshwater habitat.

NMFS's analysis uses the following four steps to determine whether properly functioning conditions will be present to ensure the survival and recovery of anadromous salmonids (explained in greater detail in Attachment 2).

1. Define the biological requirements of the listed species. To determine whether a proposed or ongoing action is likely to jeopardize a listed species or destroy/adversely modify its critical habitat, it is first necessary to define the biological requirements for ensuring the continued existence (in terms of survival and recovery) of the species. Anadromous salmonid biological requirements can be expressed in terms of environmental factors that define properly functioning freshwater habitat necessary for survival and recovery of the ESU. These environmental factors are known to result in sufficient prespawning survival, egg-to-smolt survival, and upstream/downstream migration survival rates to ensure survival and recovery of listed species.

2. Evaluate the relevance of the environmental baseline to the species' current status. The environmental baseline represents a basal set of conditions to which the effects of the proposed or continuing action would be added. The reason for determining the species' status under the risks presented by the environmental baseline (without the effects of the proposed or continuing

action) is to better understand the relative significance of the action's effects upon the species' likelihood of survival and chances for recovery when those effects are added to the environmental baseline. The greater the risks the species face at the time of consultation, the more significant any additional adverse effects caused by the proposed or continuing action will be. NMFS assumes that the poorer the functional condition of these elements, the higher the risk to anadromous salmonids from additional action-related adverse effects.

3. Determine the effects of the proposed or continuing action on listed species. In this step of the analysis, NMFS examines the likely effects of the proposed action on the species. The analysis may consider the impact in terms of how the proposed action affects anadromous salmonid habitat and/or the level of incidental take caused by the action. The analysis includes effects that may or may not be within the action agencies' discretion to correct.

4. Determine whether; a) the species can be expected to survive (with an adequate potential for recovery) under the effects of the proposed or continuing action, the environmental baseline, and any cumulative effects, and b) the action will appreciably diminish the value of critical habitat for both the survival and recovery of the species. In this step of the analysis, NMFS determines whether the specific action under consultation is likely to jeopardize the continued existence of the listed species or result in destruction/adverse modification of critical habitat. As described above, NMFS uses the "Matrix of Pathways and Indicators" (NMFS 1996) to determine whether actions would further degrade the environmental baseline or hinder attainment of properly functioning aquatic conditions. Actions that do not retard attainment of properly functioning aquatic conditions when added to the environmental baseline would not jeopardize the continued existence of anadromous salmonids.

B. Determinations for MTH Project. The four steps of the jeopardy analysis described above were applied to UR cutthroat trout and its proposed critical habitat at the MTH project, and these steps are described below.

1. Define the biological requirements of the listed species. Biological requirements and critical habitat for UR cutthroat trout are described in Attachment 1 and in "**III.A. UR Cutthroat Life History**" above.

2. Evaluate the relevance of the environmental baseline to the species' current status. The status of UR cutthroat trout under the environmental baseline is described in Attachment 1. The environmental baseline in the Elk Creek subbasin relevant to UR cutthroat trout is described in "**IV.B. Environmental Baseline**" above. The environmental baseline in the Elk Creek subbasin is evaluated in tabular form in Table 5 above.

3. Determine the effects of the proposed or continuing action on listed species. The effects of the proposed action (including effects of interrelated and interdependent actions) are described in

"**V.A. Effects of Proposed Action**" above. The effects are summarized in tabular form in Table 5 above.

4. Determine whether; a) the species can be expected to survive (with an adequate potential for recovery) under the effects of the proposed or continuing action, the environmental baseline, and any cumulative effects (jeopardy), and b) the action will appreciably diminish the value of critical habitat for both the survival and recovery of the species (destruction/adverse modification of critical habitat).

a. Jeopardy. As explained above, and in more detail in Attachment 2, actions that do not retard attainment of properly functioning aquatic conditions when added to the environmental baseline, are not likely to jeopardize the continued existence of anadromous salmonids or result in destruction/adverse modification of critical habitat. NMFS applied its evaluation methodology (NMFS 1996; see summary in Table 5 above) to the proposed action and found that it is likely to cause long-term degradation of most of the environmental baseline indicators in the action area (many of which are already degraded and "not properly functioning") which provide for the biological requirements of UR cutthroat trout. Long-term degradation of these indicators would result from the construction and operation of the MTH Dam (including effects of interrelated and interdependent actions), and the cumulative effects (as defined in the ESA) in the Elk Creek subbasin over the lifetime of the project.

The MTH project, as currently proposed, would result in the permanent loss of UR cutthroat trout habitat, long-term degradation of most UR cutthroat trout indicators at the Elk Creek subbasin scale (largely due to interrelated and interdependent effects), and adverse mercury effects on UR cutthroat trout in the Elk Creek subbasin over at least the next century. Based on the best available information (i.e., environmental baseline information, the known status of UR cutthroat trout, and the life history of this ESU), NMFS believes that (1) the environmental baseline within the range of UR cutthroat trout is generally poor (the poor condition of the environmental baseline was a primary factor in the decline of this species and its listing as endangered), (2) the habitat above the MTH damsite is important and potentially essential to the Elk Creek subbasin population of UR cutthroat trout, and (3) the Elk Creek subbasin population of UR cutthroat trout is important and potentially essential to the ESU (see Attachments 1 and 2). Thus the alteration or reduction in the quality, distribution, and abundance of UR cutthroat trout habitat at the Elk Creek subbasin scale due to the proposed MTH project (affecting prespawning survival, egg-to-smolt survival, and upstream/downstream migration survival rates) is likely to appreciably diminish the likelihood of survival and recovery of UR cutthroat trout. Therefore, the proposed construction and operation of the MTH Dam (including effects of interrelated and interdependent actions), taken together with the cumulative effects in the Elk Creek subbasin over the lifetime of the project, are likely to jeopardize UR cutthroat trout.

If the only result of building MTH Dam was higher base flows and lower stream temperatures in the mainstem of Elk Creek in the summer and fall, NMFS would agree with BOR that this project is not likely to jeopardize UR cutthroat trout. However, based on the available information, the loss of a significant amount of anadromous salmonid habitat that has considerable potential for recovery (due to the Oregon CSRI and the Federal NWFP), along with the likely mercury effects as well as the interrelated and interdependent effects of the MTH project over the next century, are cumulative detriments of the proposed MTH project to UR cutthroat trout that are not outweighed by the proposed mitigation measures.

<u>b. Destruction/Adverse Modification of Critical Habitat</u>. UR cutthroat trout proposed critical habitat is described in Attachment 1. The proposed critical habitat covers all historical habitat in the Umpqua Basin, including the MTH project area (except for the reach of Walker Creek above the natural barrier near the mouth of this tributary). Not counting Walker Creek above the barrier and assuming that UR cutthroat trout use intermittent streams, there are 12-16 miles of UR cutthroat trout habitat above the MTH damsite. The MTH project would degrade the "essential features" of the proposed UR cutthroat trout critical habitat by inundating, blocking, or otherwise affecting them. These essential features include adequate substrate, water quality, water quantity, water temperature, food, riparian vegetation, and access (see 62 FR 40788; July 30, 1997).

While little is know of the value of the affected habitat to the UR cutthroat trout ESU, it can be inferred from UR cutthroat trout life history that the habitat affected by the MTH project is important and potentially essential to the Elk Creek subbasin population of UR cutthroat trout. Besides providing critical habitat essential features as noted above, this habitat fits the description of spawning and fry rearing habitat as described above in "**III.A. UR Cutthroat Life History**" and is likely to provide valuable habitat for this species.

Low-gradient, headwater habitat in mainstem tributaries, such as that which would be inundated by the MTH project, provides the spawning and fry rearing habitat necessary to meet the biological requirements of this species. Degradation and loss of such habitat is one of the primary factors in the decline of UR cutthroat trout, and significantly contributed to the listing of this species as endangered (see Attachment 1 and 61 FR 41514; August 9, 1996). As shown in Table 5 above, the environmental baseline in the Elk Creek subbasin is "at risk" or "not properly functioning."

As explained in Attachment 2, "destruction or adverse modification" of critical habitat is defined as "a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species." Based on the best available information (i.e., environmental baseline information, the known status of UR cutthroat trout, and the life history of this ESU), NMFS believes that (1) the environmental baseline within the range of UR cutthroat trout is generally poor (the poor condition of the environmental baseline was a primary factor in the decline of this species and its listing as endangered), (2) the habitat above the MTH damsite is important and potentially essential to the Elk Creek subbasin population of UR cutthroat trout, and (3) the Elk Creek subbasin population of UR cutthroat trout is important and potentially essential to the ESU. The MTH project would inundate or block at least 12 miles of currently accessible anadromous UR cutthroat trout habitat in the headwaters of Elk Creek for at least the next 100 years.

The MTH project would eliminate this important and potentially essential anadromous UR cutthroat trout habitat as well as affecting habitat throughout the Elk Creek subbasin (see jeopardy analysis above). This is likely to result in an appreciable diminishment of the value of critical habitat for the survival of the species. In addition, the MTH project would preclude the use of this habitat during the course of the future recovery of the species, also appreciably diminishing the value of critical habitat for recovery. Thus NMFS concludes that the proposed MTH project is likely to destroy and adversely modify proposed UR cutthroat trout critical habitat.

C. **Summary**. NMFS has determined that, based on the available information, the proposed MTH project is likely to jeopardize the continued existence of UR cutthroat trout, and result in the destruction and adverse modification of proposed critical habitat.

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VII. Reasonable and Prudent Alternative

The regulations implementing section 7 of the ESA (50 CFR 402.2) define reasonable and prudent alternatives (RPAs) as alternative actions, identified during formal consultation, that (1) can be implemented in a manner consistent with the intended purpose of the action, (2) can be implemented consistent with the scope of the action agency's legal authority, (3) are economically and technologically feasible, and (4) would, in NMFS's opinion, avoid the likelihood of jeopardizing the continued existence of listed species and avert the destruction or adverse modification of critical habitat. UR cutthroat trout critical habitat has been proposed (62 FR 40786; July 30, 1997) and it includes the MTH project area. The designation of critical habitat must be completed by July 30, 1998 (i.e., within one year of the July 30, 1997, publication of the proposed critical habitat rule).

NMFS has determined that the MTH project is likely to jeopardize the continued existence of UR cutthroat trout and result in the destruction and adverse modification of proposed critical habitat (see "**VI.B. Determinations for MTH Project**, 4a" above). NMFS has identified an RPA that would avoid the likelihood of jeopardizing the continued existence of UR cutthroat trout and avert adverse modification or destruction of essential features of proposed critical habitat. NMFS reviewed the RPA and found it consistent with the regulatory requirements outlined in the first paragraph under "**VII. Reasonable and Prudent Alternative**" above. The RPA consists of four components: (1) compensation for the loss of UR cutthroat trout habitat due to the MTH project by restoration of an equal or greater amount of similar habitat primarily within the Elk Creek subbasin, (2) minimization of potential mercury effects from the Elkhead Mine area on UR cutthroat trout habitat, (3) minimization of potential effects of actions that are interrelated and interdependent to the MTH project on UR cutthroat trout habitat, and (4) monitoring and reporting of the implementation of each component. The BOR shall enforceably condition its funding of the MTH project to require full implementation of each component of this RPA. The criteria for each component are described below:

1. Compensate for the loss of UR cutthroat trout habitat due to the MTH project by implementing each of the headwater habitat restoration programs below. Habitat restored by these programs must be maintained in the restored condition until the MTH project is removed.

   a. Restore at least 12 miles of headwater UR cutthroat habitat by protecting riparian habitat. Flow augmentation alone does not constitute habitat restoration but may be used to complement it.

      i. Apply whichever of the following standards provides the most riparian protection in order to provide for the restoration of degraded habitat, and maintenance of restored habitat:

         a. Prevention of all ground and vegetation disturbance within 100 feet of both sides of the active channel of the stream until the MTH project is removed, except for (1) maintenance of existing roads and structures, and (2) restoration activities approved by ODFW and NMFS, or

         b. (1) For stream reaches in forested land, apply the riparian protection measures or their functional equivalent in NMFS's proposal to the Oregon Board of Forestry to amend forest practice rules (being done under the Memorandum of Agreement on implementation of the Oregon Coastal Salmon Restoration Initiative), available in early 1998 from NMFS, and (2) For stream reaches in agricultural land, comply with provisions of an Agricultural Water Quality Management Area Plan (AWQMAP) applicable to that area and approved by DEQ and NMFS, if available.

      ii. Use no more than three non-contiguous stream reaches for the total length of at least 12 miles of restored habitat. Only those riparian segments within each of these areas that are protected (according to the above definition) shall be counted towards the total habitat restoration total. For example, if a five mile stream reach is selected for habitat restoration, but only a total of 60% (three miles) of the riparian area scattered throughout the five mile reach can be protected, then only three miles will be counted towards the total.

iii. Locate at least two-thirds (i.e., at least eight miles) of the habitat restoration within the Elk Creek subbasin. Locate the remainder either within the Elk Creek subbasin or elsewhere within the Umpqua Basin.

iv. Finalize agreements resulting in protection (according to above definition of "protecting riparian habitat"), for the duration of the project of (1) at least half of the 12 mile minimum prior to closing off fish passage at the damsite (the point in time when Elk Creek is diverted in a manner that eliminates fish passage), and (2) the remainder of the 12 mile minimum prior to BOR's determination of "substantial completion" for the MTH project.

b. Provide fish passage access to at least four miles of currently blocked UR cutthroat trout habitat by replacing or modifying existing culverts on the Douglas County road system in the Elk Creek subbasin.

i. Select high priority culverts from the ODFW and ODOT June 1997 culvert inventory for Douglas County.

ii. Replaced or modified culverts must be consistent with guidelines provided by NMFS (any exceptions to this must be approved by NMFS).

iii. Complete all culvert replacements or modifications prior to closing off fish passage at the damsite.

2. Minimize potential mercury effects from the Elkhead Mine area on UR cutthroat trout habitat by implementing each of the erosion control programs below. All programs must be maintained as described until the MTH project is removed.

a. Modify the road system in the Elkhead Mine vicinity (Figure 4 of USDI 1997b) to provide for containment of runoff and sediment prior to entering the MTH reservoir.

i. All culverts in this area will be constructed with small retaining ponds to allow sediments to settle in an area which Douglas County road crews shall clean as they fill. Sediment removed from these retaining ponds shall be transferred to a sanitary landfill.

ii. Complete the modifications prior to closing off fish passage at the damsite.

b. Minimize erosion of the road surface sampled by CH_2M Hill that had a mercury concentration of 9.82 µg/g (CH_2M Hill 1995, p.2-10) by implementing the following measures on the road from the sample site to the inundation area:

i. Waterbar and revegetate (with native species) the road surface.

ii. Barricade the road to exclude all motor vehicles.

iii. Complete implementation of the measures prior to closing off fish passage at the damsite.

c. Require Douglas County to enter into binding land management agreements, such as acquiring easements or other deed restrictions, with the landowners of the claim area in sections 21 and 22 (Figure 4 of USDI 1997b) to minimize erosion from the land.

i. The agreements must result in erosion control plans that are approved by DEQ and NMFS prior to closing off fish passage at the damsite.

ii. If agreements that satisfy the requirements of 2.c.i. above cannot be reached with the landowner(s), Douglas County will purchase sufficient property to satisfy these requirements with NMFS's and DEQ's approval prior to closing off fish passage at the damsite.

3. Minimize potential effects of actions that are interrelated and interdependent to the MTH project on UR cutthroat trout habitat.

a. Require Douglas County to enter into binding land management agreements with affected landowners to prevent new agricultural, industrial and other development outside of September 1997 urban growth boundaries that would not occur directly or indirectly but for the MTH project within 100 feet of both sides of the active channel of potential UR cutthroat habitat in the Elk Creek subbasin downstream of MTH Dam until the project is removed. This does not apply to activities required for project construction (e.g., pipeline installation).

b. If agreements that satisfy the requirements of 3.a. above cannot be reached with the landowner(s), require Douglas County to prevent development, as defined in 3.a. above, within the ownership in question by whatever means necessary to achieve equivalent protection.

c. Measures proposed to implement 3.a. and 3.b. above require NMFS's prior approval.

4. Provide an annual monitoring report by December 31 to NMFS on the implementation of each component of the RPA.

The RPA is designed to minimize or avoid adverse effects to UR cutthroat trout and to essential features of its proposed critical habitat. Proper implementation of the RPA would fully compensate for the UR cutthroat trout habitat loss due to the MTH project, minimize or avoid adverse mercury effects to this species due to the project, and minimize or avoid adverse effects from actions interrelated and interdependent to the MTH project to this species. Implementation of the RPA, in addition to other mitigation proposed for the MTH project and the benefits of the project to UR cutthroat trout in the mainstem of Elk Creek below the damsite (see "**V.A. Effects of Proposed Action**" above), will begin restoring essential features of UR cutthroat trout proposed critical habitat and result in an improvement in the environmental baseline in the action area. Adoption of the RPA is therefore not likely to jeopardize the continued existence of UR cutthroat trout or result in the adverse modification or destruction of essential features of proposed critical habitat. Because this Biological Opinion has found jeopardy and destruction/adverse modification of critical habitat, the Bureau of Reclamation is required to notify NMFS of its final decision on the implementation of the RPA.

VIII. Conservation Recommendations

Section 7 (a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitat, or to develop additional information. NMFS believes the following conservation recommendations are consistent with these obligations, and therefore should be implemented by the BOR:

1. The BOR and Douglas County should encourage the cities that will use water from the MTH project to develop greenways along streams within their urban growth boundaries. These greenways should be designed to provide for the recovery of aquatic and riparian habitat.

2. The BOR and Douglas County should encourage the formation and development of an Elk Creek watershed group consisting of as many interested parties as possible to plan, implement, and monitor UR cutthroat habitat restoration activities in this subbasin.

3. The BOR and Douglas County should monitor aquatic macroinvertebrate species richness and abundance before, during, and after MTH project construction in Elk Creek (downstream of the damsite) and Yoncalla Creek (downstream of flow augmentation) to provide a measure of the project's long-term effect on stream ecosystem health.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects, or those that benefit listed species or their habitat, NMFS requests notification of the implementation of any conservation recommendations.

IX. Reinitiation of Consultation

Based on the information in the BA (USDI 1996a) and BA amendments (USDI 1997a,b), NMFS anticipates that incidental take of UR cutthroat trout could occur as a result of the actions covered by this Biological Opinion. Consultation must be reinitiated if (1) the amount or extent of taking specified in the Incidental Take Statement is exceeded, or is expected to be exceeded, (2) new information reveals effects of the action that may affect the listed species in a way not previously considered, (3) the action is modified in a way that causes an effect on the listed species that was not previously considered, or, (4) a new species is listed or critical habitat is designated that may be affected by the action (50 C.F.R. 402.16).

X. References

Section 7(a)(2) of the ESA requires biological opinions to be based on "the best scientific and commercial data available." This section identifies the data used in developing this opinion in addition to the BA and additional information requested by NMFS.

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XI. Incidental Take Statement

Sections 4(d) and 9 of the ESA prohibit any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of a listed species without a specific permit or exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, and sheltering. Harass is defined as actions that create the likelihood of injuring listed species to such an extent as to significantly alter normal behavior patterns which include, but are not limited to, breeding, feeding, and sheltering. Incidental take is take of a listed animal species that results from, but is not the purpose of, the Federal agency or the applicant carrying out an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action (construction and operation of MTH Dam as modified by the RPA) is not considered prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary; they must be implemented by the action agency so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The BOR has a continuing duty to regulate the activity covered in this incidental take statement. If the BOR (1) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

An incidental take statement specifies the impact of any incidental taking of an endangered or threatened species. If necessary, it also provides reasonable and prudent measures that are necessary to minimize impacts and with which the action agency must comply.

A. Amount or Extent of the Take

NMFS anticipates that the action covered by this Biological Opinion (construction and operation of MTH Dam as modified by the RPA) has more than a negligible likelihood of resulting in incidental take of UR cutthroat trout because of detrimental effects on multiple habitat parameters (see "**V.D. Summary**" above). Effects of management actions such as these are largely unquantifiable in the short term, and are not expected to be measurable as long-term effects on the species' habitat or population levels due to inadequate data. Therefore, even though NMFS expects incidental take to occur due to the action covered by this Biological Opinion, the best scientific and commercial data available are not sufficient to enable NMFS to estimate a specific amount of incidental take to the species itself. In instances such as these, the NMFS designates the expected level of take as “unquantifiable”. Based on the information in the BA (USDI 1996a) and BA amendments (USDI 1997a,b), NMFS anticipates that an unquantifiable amount of incidental take could occur as a result of the action covered by this biological opinion. NMFS identified four aspects of the proposed construction and operation of the MTH project as modified by the RPA that could result in the incidental take of UR cutthroat trout: (1) habitat loss above the damsite, (2) mercury effects, (3) interrelated and interdependent actions, and (4) inadequate monitoring.

The most significant amount of incidental take of UR cutthroat trout caused by the MTH project as modified by the RPA is expected to be from the first aspect, habitat loss above the damsite. The incidental take due to habitat loss above the damsite is authorized by this opinion. The amount of incidental take authorized for the third aspect, interrelated and interdependent actions, is minimal. No take is authorized for mercury effects or inadequate monitoring. In this opinion, NMFS has determined the anticipated level of take due to the MTH project as modified by the RPA is not likely to jeopardize the continued existence of UR cutthroat trout, or destroy or adversely modify its proposed critical habitat.

<u>1. Habitat loss above damsite</u>. All incidental take of UR cutthroat trout due to habitat loss above the damsite from the MTH project is authorized by this biological opinion. This take is authorized because (1) the habitat above the damsite is currently in degraded condition, (2) an equal or greater amount of currently degraded UR cutthroat trout headwater habitat will be restored by the implementation of RPA component #1 (p.67-68), and (3) the MTH project is expected to restore summertime streamflows and temperatures in Elk Creek below the damsite.

<u>2. Mercury effects</u>. The MTH project has the potential to exacerbate mercury effects on UR cutthroat trout due to potential concentration of mercury in the water and sediments of MTH Reservoir. Incidental take of UR cutthroat trout due to mercury effects is likely to occur if total mercury body burdens exceed 1.0 µg Hg/g wet weight in individual fish. These potential mercury effects are expected to be avoided by the implementation of RPA component #2 (p.68-69 above), thus no incidental take of UR cutthroat trout in MTH Reservoir (lacustrine) or Elk Creek below the dam (potentially anadromous) due to mercury effects is authorized.

<u>3. Interrelated and interdependent actions</u>. The MTH project has the potential to result in incidental take of UR cutthroat trout due to the effects of interrelated and interdependent actions. These potential effects will be minimized or avoided by the implementation of RPA component #3 (p.69).

<u>4. Inadequate monitoring</u>. Failure to adequately monitor the effects of the MTH project on anadromous salmonids and their habitat has the potential to indirectly result in incidental take of UR

cutthroat trout. Adequate monitoring would track the effects of the project and determine if (1) the predicted effects of the project are occurring, and (2) unexpected adverse effects and/or incidental take are occurring. Effects of inadequate monitoring are expected to be avoided by the implementation of the measures below, thus no incidental take of UR cutthroat trout due to inadequate monitoring is authorized.

B. Reasonable and Prudent Measures

NMFS believes that the following reasonable and prudent measures are necessary and appropriate to minimize the incidental take of UR cutthroat trout due to the construction and operation of the MTH project, as modified by the RPA.

1. The BOR shall require Douglas County to: (1) fully implement all criteria of RPA component #1 (p.67-68 above), (2) maintain minimum flows of $35.0 cfs in Elk Creek at Boswell Springs from July 1 to September 30 unless NMFS and ODFW agree to an exception, and (3) maintain maximum daily average stream temperatures of <60.0° F at Boswell Springs from July 1 to September 30 unless NMFS and ODFW agree to an exception. Failure to meet these habitat restoration performance standards will be considered a violation of this incidental take statement.

2. The BOR shall require Douglas County to: (1) fully implement all criteria of RPA component #2 (p.68-69 above), (2) sample the total mercury body burdens in individual UR cutthroat trout from MTH Reservoir and Elk Creek below the dam starting two years after the MTH Dam is closed for filling, and every two years thereafter (incidental take of UR cutthroat trout due to mercury effects is likely to occur if total mercury body burdens exceed 1.0 µg Hg/g wet weight in individual fish). Sampling protocol shall be agreed to by NMFS, ODFW, and Douglas County.

3. The BOR shall require Douglas County to fully implement all criteria of RPA component #3 (p.69 above) to minimize the incidental take of UR cutthroat trout due to the effects of the MTH project's interrelated and interdependent actions.

4. The BOR shall require Douglas County to: (1) before construction begins (i.e., prior to diverting Elk Creek for dam foundation dewatering), submit a monitoring plan to NMFS that includes proposed methods, timing, funding, and reporting of streamflow, water quality, stream habitat, riparian habitat, and salmonid population monitoring at the MTH project (the monitoring plan must also cover monitoring of the implementation of RPA components #1-3), and (2) starting in 1999, provide an annual monitoring report by December 31 to NMFS on the implementation and results of the monitoring plan.